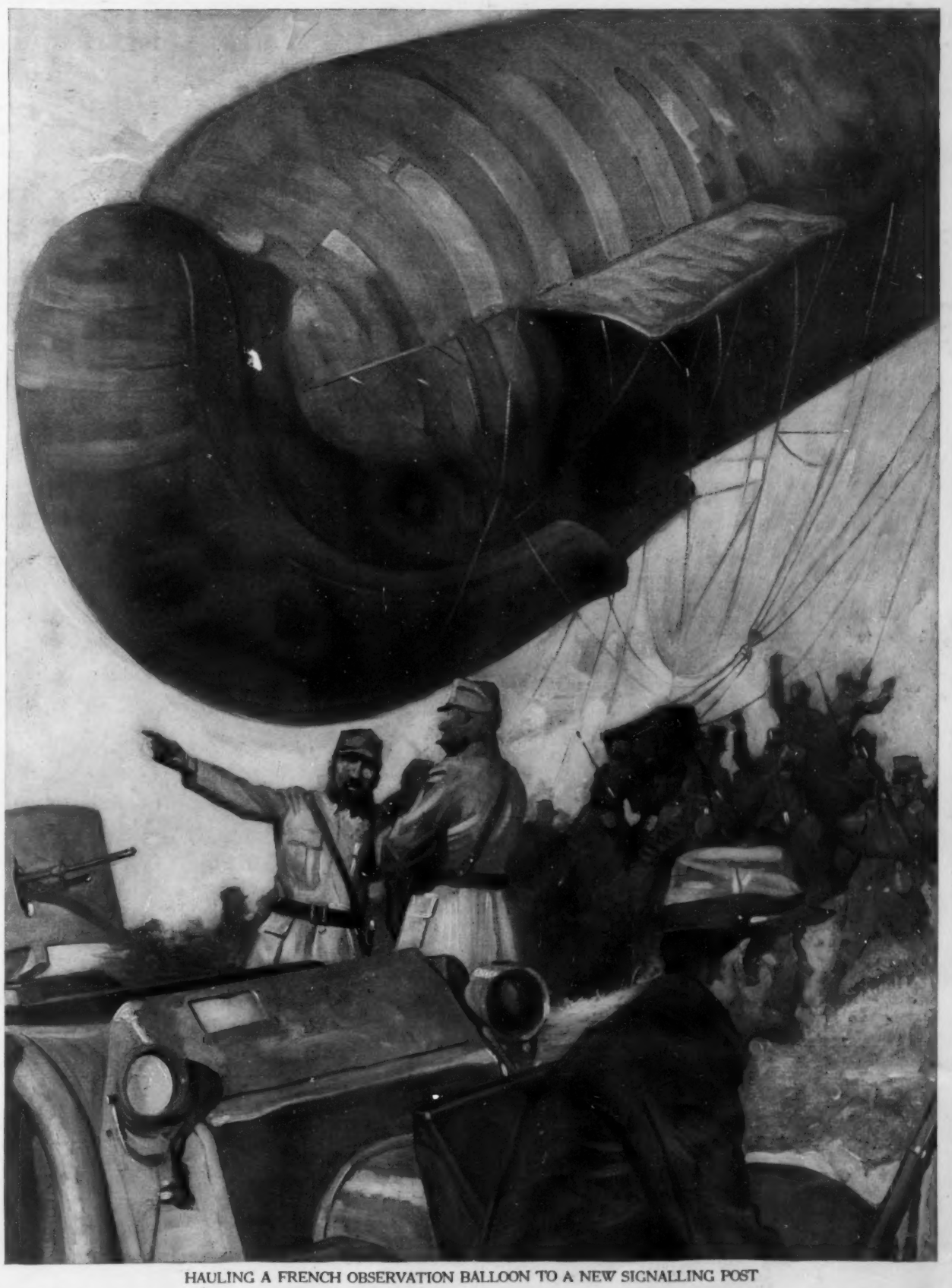
SCIENTIFIC AMERICAN



HAULING A FRENCH OBSERVATION BALLOON TO A NEW SIGNALLING POST

Vol. CXIV. No. 7
February 12, 1916

Munn & Co., Inc., Publishers
New York, N. Y.

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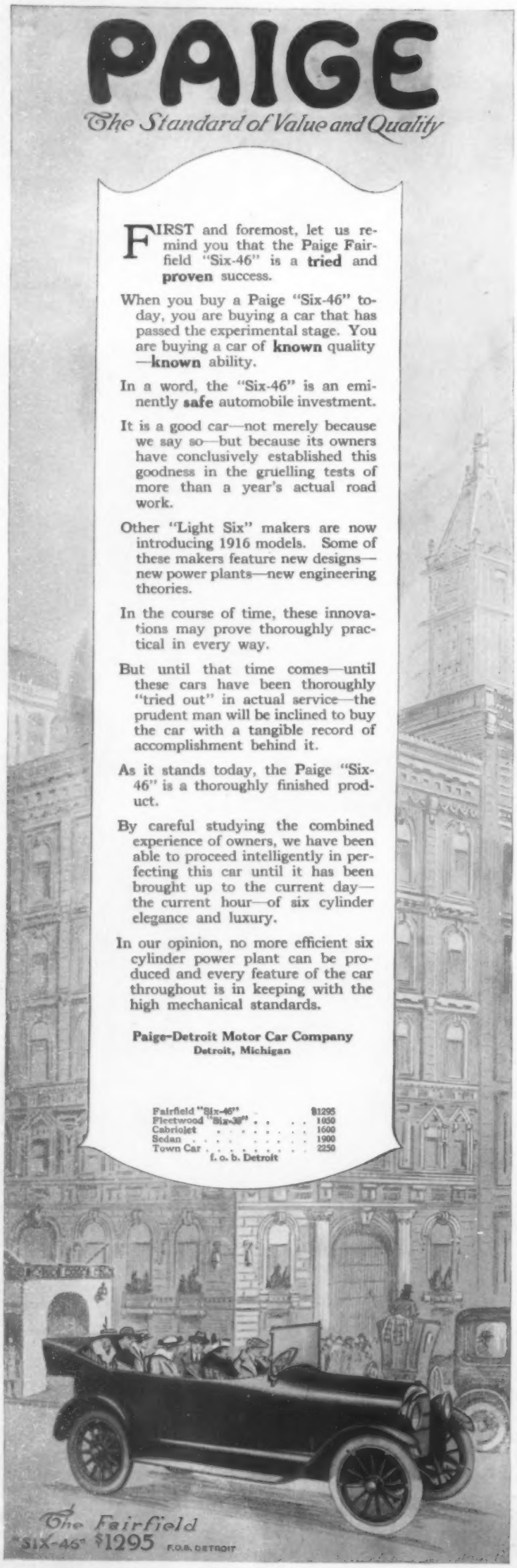

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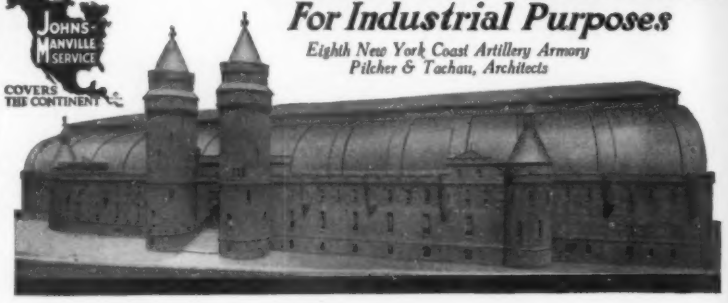

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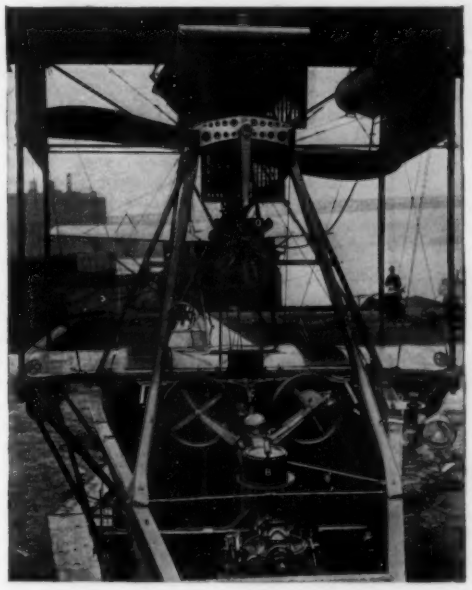
SEVENTY-SECOND YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXIV. NUMBER 7 — NEW YORK, FEBRUARY 12, 1916 — 10 CENTS A COPY $3.00 A YEAR

Gyroscope of the type employed for the installation aboard the U. S. destroyer "Worden"



Installation on board an aeroplane of the Sperry stabilizer and kindred devices

Sperry gyroscopic master compass with lower part binnacle down to show mechanism

The Seventh Award of the Scientific American Medal for Safety Devices

By Dr. William H. Tolman, Director American Museum of Safety

EIGHT years ago the American Museum of Safety was formed by a small group of men interested in safeguarding life and limb from industrial and other accidents. For the greater part, the trustees were editors of technical publications, which supported the new movement with great enthusiasm. That the work of the museum has been eminently successful is evidenced by the fact that to-day there are several Museums of Safety throughout the United States. Furthermore, the great number of "Safety First" societies, committees and other organizations, which have for their object the elimination of carelessness and faulty equipment as a means of preventing accident, may be said to be a direct result of the inspiration received from the work of the American Museum of Safety.

Early in the history of the museum it was felt that some encouragement should be offered to corporations and individuals to invent and install safety devices, as well as to look after the welfare of employees. The SCIENTIFIC AMERICAN was the first to offer a medal for this purpose, and it has now been awarded seven times for the most efficient device invented within three years of the award and exhibited at the museum. In the SCIENTIFIC AMERICAN of February 7th, 1914, the first five winning devices were illustrated and described. These are as follows: 1908.—The Rich Marine Fire Extinguisher Company; 1909.—The Patent Scaffolding Company; 1910.—The Norton Company; 1912.—The Draeger Oxygen Equipment Company, for the Pulmotor; 1913.—The Welin Marine Equipment Company. The sixth award, made to the Shurloc Elevator Safety Company, Inc., was described in the February 20th, 1915, issue of the SCIENTIFIC AMERICAN.

The annual meeting and banquet of the American Museum of Safety took place on February 3rd, 1916, at the Waldorf-Astoria Hotel, New York City, and was attended by many distinguished guests. Mr. Arthur Williams, President of the American Museum of Safety, presided at the banquet. The speakers were the Hon. George B. Cortelyou; Mr. Elmer A. Sperry, the SCIENTIFIC AMERICAN Medalist; Hon. Henry W. Hodge, member of the New York Public Service Commission, and Mr. William Armstrong Fairburn, President of the Diamond Match Company.

The SCIENTIFIC AMERICAN Medal was awarded to Elmer A. Sperry and the Sperry Gyroscope Company for notable achievement in securing safety in marine and aerial navigation. Professor Frederick Remsen Hutton, Sc. D., Vice-President of the Museum, in presenting the medal said, in part: "By the authority of the sovereign State of New York conferred for this purpose upon the American Museum of Safety, and by direction of its Board of Trustees and in its name and behalf, this medal is now conferred upon you, for distinguished achievement in securing safety in the department of productive industry in which you have won your fame."

The general principles on the basis of which the Museum recognizes successful achievement are as follows: (1) Applicability. Does the device secure safety for a large number of persons or in a great variety of conditions? (2) Practicability. Can the device be

Scientific American Medal for safety devices, awarded to Elmer A. Sperry

used economically and successfully? It must not be too cumbrous or intricate to apply or operate. (3) Simplicity. It must not be so complicated that experts are required to handle or keep it in repair. (4) Reliability. It must not be liable to derangement or failure to work in emergencies. (5) Durability. It must not be so delicate or need such fine adjustment that it will not stand up in service. (6) Commercial availability. It must not be too expensive to install or maintain in operation; it must be obtainable in an open market for the use of all.

The remarkable work of Mr. Elmer A. Sperry, in the application of the gyroscope to many purposes, has been of such an interesting and unique nature that his inventions have been often described in the technical press. Not the least interesting of these is the gyroscopic stabilizer for use on ships ranging from a launch to the mightiest of steamers. Unfortunately, space does not permit of a description of the gyroscopic stabilizer as applied to vessels for the purpose not only of preventing the usual rolling caused by roughness of the water, but also for the reversal of this operation, namely, the rolling of vessels intentionally as an aid to forcing a way through an ice field. In the SCIENTIFIC AMERICAN of December 18th, 1915, there appears a description of the gyroscope as a ship stabilizer, with special reference to the tests on the yacht "Widgeon," which were highly successful. In the SCIENTIFIC AMERICAN SUPPLEMENT of March 29th, 1913, there appears a more detailed description of the Sperry gyroscopic stabilizer for ships. In connection with the stabilizer, Mr. Sperry has also devised a gyroscopic mechanism for recording the roll and pitch of vessels at sea, which was described in the SCIENTIFIC AMERICAN of August 23rd, 1913. A similar apparatus known as the Pallograph was described in the issue of January 8th, 1916. The Sperry gyroscopic aeroplane stabilizer and its numerous companion inventions was described in the issues of June 7th, 1913, and August 8th, 1914, respectively. In the SCIENTIFIC AMERICAN of June 29th, 1912, there appeared a detailed description of the Sperry gyroscopic compass which is widely employed to-day aboard war vessels, especially submarines. Mr. Sperry's inventions, in a word, illustrate what can be done by thoroughly mastering the principles of such simple devices as the gyroscope and then applying them to a useful purpose.

At the annual meeting of the American Museum of Safety there were also awarded, aside from the SCIENTIFIC AMERICAN Medal, a number of others. The Travelers' Insurance Company's Medal went to Mr. Wilbur C. Fisk and the Hudson & Manhattan Railroad Company, for achievement in accident prevention among its personnel and for promoting safety for the traveling public. The Louis Livingston Seaman Medal was awarded to Mr. William A. Fairburn and the Diamond Match Company for the elimination of occupational disease in the match industry. The E. H. Harriman Gold Medal was awarded to the Cincinnati, New Orleans & Texas Pacific Railroad which was considered as the American steam railroad which, during the year, had been most successful in protecting the lives and health of its employees and the public. The Anthony N. Brady Gold Medal went to the Union Traction Company of Indiana, which was recognized as the American electric railway company which, for the year of the award, had done most to conserve the safety and health of the public and its employees.

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

The Significance of Science

THERE are quite a large number of people in the world who are never tired of attacking science and the scientific way of looking at things; and the existence of the great war in Europe has given them a greater boldness and prominence than ever before. And, also, it must be admitted it has given them a greater apparent justification. Science, they assert, has piled up knowledge without in any way affecting the baser elements of human nature. The fruits of science are all about us in the forms of electric street cars, railways, telephones, submarine cables and a thousand other conveniences; yet a cursory examination of any newspaper will convince us that the old vices of mankind flourish as strongly as ever, and to crown it all, we are living in a time when the greatest slaughter in the history of the world is taking place. It would appear that the only change science has wrought is a change in the material conditions of mankind. It must be confessed that there is much to be said for this point of view, and yet, can it be true that the pure, disinterested search after knowledge which has inspired men to live laborious days and to die, in some cases, shameful deaths, is to have no other result than to add to our bodily comforts or to increase the murderous power of our engines of destruction? One cannot rest content with this conclusion, and indeed, there is no reason to do so. Science has a spiritual side, but in order to see it, it is necessary to make a distinction between science and its applications.

The true aim of science, expressed in a word, is to increase the self-consciousness of man. We have emerged from lowly forms of life where self-consciousness is almost, if not quite, non-existent. Each advance has been in the direction of the acquisition of a greater degree of self-consciousness. Long ages ago man commenced to distinguish himself from the trees and stones about him. He began to form a picture of his universe and of himself as related to that universe. His consciousness grew: he distinguished between one tribe and another, between one family and another, between one individual and another. When Copernicus propounded his theory that the earth revolves about the sun, he altered, at one blow, man's conception of the relation between himself and the universe. Man saw himself more clearly: he was no longer the miraculously unique creature he had supposed himself to be. Darwin, with his origin of species, effected another great change in man's estimate of himself. Again man's self-consciousness, his conception of his relations to everything outside himself, acquired an extension and intensification. The main function of philosophy has been of the same kind and it is interesting to note that it is now thought that the true significance of art is to be found in the same direction.

With this extension of self-consciousness comes a fuller appreciation of the essential nature of man and of his possibilities. By discovering man's true relation to the universe, we see also how he may best live in peace and harmony with that universe. Every scientific discovery, every discovery from whatever source which shows us more clearly what this world is in which we live, reacts upon man himself and causes a further adjustment of his relations to that world. Now the true argument against vice and against war is that these things are not in harmony with that further development of mankind which science has shown us to be a possibility. People may be found to argue that war is a benefit. They talk about "biological necessity"—they garble science. There may even be people who argue that vice is a benefit. But the whole trend of scientific thought is in the opposite direction. It is incorrect to say that science has no moral aspect. The mind of man is not divisible into water-tight compartments, although writers of philosophical text-books sometimes find it convenient to assume this unnatural division, and science, philosophy and art, all have, and must necessarily have, a moral aspect. By showing us more clearly our own nature and the nature of the world about us, they implicitly condemn certain activities and foster others.

If this aspect of science has been far less insisted on than its material applications it is due, in some measure, to the newness of the subject. The true significance of any great human departure is always the last thing we perceive about it; the obvious points are the ones we see first. Scientific men are every now and again delivering themselves of speeches with the object of justifying science. Usually they refer one to its applications. It has given us pasteurized milk, electric light—and 17-inch howitzers. It has given us the means of saving life and the means of destroying it. It is difficult to see exactly what this line of argument proves. But we are inclined to think that this kind of argumentation is largely beside the point. There is an old and familiar saying, "The truth shall make you free," free from the baser elements within ourselves. And it is because the spirit of science tends in this direction that science is most emphatically worth while. The body of science does, on occasion, assume strange forms, but its spirit has one fixed direction.

The Need of Trade Mark Treaties Between American Republics

IN these days, when American Republics are drawing together in closer commercial relationship, and our merchants are undertaking to develop a market for their products in Central and South American countries, it is well to draw attention to serious complications now existing in the protection of trade marks. A very able paper on this subject prepared by the Hon. J. T. Newton, Asst. Commissioner of Patents, was read recently before the Pan-American Congress. The paper is of utmost importance to owners of trade marks and for this reason we are republishing it in full in this week's issue of the SCIENTIFIC AMERICAN SUPPLEMENT.

We are entirely in accord with the plea put forward by Mr. Newton for coöperation between the United States and other American states in the protection of trade marks and trade names. As Mr. Newton points out, in a number of cases, trade marks which have become valuable through long and continued use in the United States, have been appropriated by unscrupulous people in other states and when the American manufacturer endeavored to import his merchandise with his trade mark into such states his goods were denied entry and in several cases were confiscated.

Mr. Newton draws attention to the lack of harmony between trade mark laws of various republics. Some of them differ very radically from others and this has caused great confusion. His article makes a strong plea for a treaty relationship between the United States and Central and South American countries, for the purpose of enacting uniform trade mark legislation. In connection with such legislation he suggests that two bureaus be established, one in Havana, Cuba, and the other in Rio Janeiro, Brazil. These bureaus would have charge of the registration of trade marks of the various countries involved.

The Perennial Martians

ANOTHER opposition of Mars has taken place, and if history repeats itself the Sunday supplements should be telling us just what horse-power is ordinarily required to operate a Martian pumping-station, what kind of harvesting machinery the Martians use in gathering their crops, and how a self-confessed "scientist" in Podunk proposes to telegraph to our neighbors in the ruddy planet. Our one hope in the present instance of escaping these periodic lucubrations is the possibility that martial affairs on earth may successfully vie in interest with Martian affairs elsewhere.

The question of the habitability of Mars is one to which some of our gravest astronomers have not scorned to direct their attention. A wordy battle has, indeed, been waged on this subject for a generation, and it has been fought with scientific weapons. On both sides there have been two general modes of attack: first, *a priori* considerations as to whether a planet of a certain size, with certain periods of rotation and revolution, and at a certain distance from the sun, could support any form of life, as we know life on earth; second, deductions from evidence actually afforded by the telescope, and latterly by the spectroscope. Nothing has been proved. The "canals" are still exactly as debatable as they were when their existence was first proclaimed by Schiaparelli, nearly forty years ago. While, on the one hand, Professor Lowell and his associates continue to draw certain surface-markings of the planet as geometrical spider-lines, we behold a committee of the British Astronomical Association publishing (no longer ago than last summer) an emphatic announcement that the evidence afforded by the last favorable opposition of Mars proves all such geometrical markings, including the "double" canals, to be mere optical illusions. We behold doubting astronomers making pilgrimages to the Lowell Observatory and coming away firmly convinced of the objective reality of canals and "oases;" while a former member of the staff of the same observatory, after seeing and drawing such objects there for years, solemnly recants and admits that he has been deluded. Lastly, we behold an accumulation of photographic evidence which also, unfortunately, appears to be susceptible of diverse interpretations.

Prof. Lowell's fascinating book, "Mars as the Abode of Life," presents the most complete and circumstantial arguments in behalf of the belief that the planet is inhabited by inteligent beings. Sweeping contradictions have, however, been called forth by this book, and they emanate from respectable sources. Such is the situation up-to-date.

Meanwhile,—to revert to the ideas disseminated by the newspapers and other popular channels of information—it is not uninteresting, as an evidence of the fact that the human mind commonly works in a rut, to note that the hypothetical "inhabitants" of Mars are almost universally assumed to be more or less transmogrified human beings. Why should they be? Are not the chances millions to one against the evolution on another planet, from the simple forms in which life must be supposed to begin (if it begins at all) on any planet, of a vertebrate animal bearing some faint resemblance to man?

Consider that a man and a radish probably descend from a common ancestral species of amœba, or whatnot, and you will begin to realize what an infinitude of shapes life may assume under various conditions of environment. Given a planet somewhat different from ours in its physical characteristics and its physical history, as Mars undoubtedly is, and we must admit the probability that the progress of organic evolution thereon has led up to things that are neither animal nor vegetable—much less quasi-human!

Using Blood in Bread

EVERY housewife knows that bread can be made more nutritious, as well as more appetizing, by adding albuminous substances such as milk and eggs to the dough. But she knows too that milk and eggs are nowadays extremely expensive items, which the ordinary family is unable to use lavishly. But as it happens there is a highly nitrogenous and nutritious substance which might take their place at a far lower cost. This is the blood which occurs as a necessary by-product in abbattoirs. Immense quantities of this are produced annually and this food-substance is rich not only in energy-producing nitrogenous compounds, but in those mineral salts which are so necessary to the body. Unfortunately, there is a wide-spread prejudice against the use of this valuable food-material, the smell, taste, color, and even the idea of blood as food being revolting to most persons.

Now, however, a German scientist, Mr. R. Droste, Staff Apothecary and Food Chemist in Hanover, comes forward with an ingenious method of using denatured blood, so to speak. By using hydrogen peroxide in mixing the "blood-bread" the sanguinary fluid is bleached, sterilized, and deodored. Moreover, the quantities of oxygen liberated when hydrogen peroxide comes in contact with organic matter form a highly effective means of aerating or "raising" the bread, making the use of yeast or baking-powder unnecessary. Mr. Droste states in the *Chemiker Zeitung* (Cöthen), of August 14th, that he has been using bread thus made in his own family for six years and finds it highly satisfactory. Blood is used in place of water in mixing up the dough. Then the peroxide is added. Besides the advantages mentioned above this powerful oxidizing agent kills destructive bacteria in the flour, such as the thread-spinning bacillus, etc. The decomposition products of the H_2O_2 are, of course, water and oxygen, both of which are desirable constituents. Mr. Droste was led to the elaboration of making this cheap, appetizing, and body-building form of bread originally by his investigations on the subject of catalytic decompositions. At first, he tells us, he used a 30 per cent solution of ordinary peroxide, but now he uses a special perhydrite. The blood is allowed to stand in the ice-box for from 24 to 36 hours. The clots are then removed by draining or filtering. The remaining serum with its rich content of nitrogen and mineral salts is what is used to mix up the bread. It may also be used for all sorts of cakes, biscuit, and fancy breads. The author urges its use in times of peace, as well as in the present time of war.

While it is doubtful if the average *haus frau* will be enthusiastic about this substitute for milk and eggs—though in truth blood is the raw material from which both are made!—the idea should receive wide application in armies, public institutions, etc.

Electricity

England to Have Women Electricians.— In order to release for military service many of the men now engaged in the electrical industry, the Electric Contractors' Association of Liverpool, England, has decided to train a number of women in electrical work.

Russian Army Secures Exposition Projectors.— It is understood that the banks of searchlight projectors used at the Panama-Pacific International Exposition for securing the "Scintillator" effects have been purchased for the use of the Russian army in the present war.

In the Cleaning of Zinc Ores, an important use has been found for the gas-filled tungsten lamp. It is difficult indeed to distinguish between the "black jack" (dark zinc ore) and lead, using other illuminants, since the two appear to be of about the same color. However, under the white light of the gas-filled lamp the two ores are readily distinguishable. It is reported that practically all zinc refineries are now installing 750-watt and 1,000-watt lamps for this purpose.

Electric Flatiron with Heat Control.—An electrical manufacturer has recently introduced on the market an electric flatiron in which a rheostat regulator is provided for regulating the amount of heat applied to the work. Heretofore, no provision for controlling the heat has been made in the conventional type of electric flatiron, and it has been necessary to regulate the heat for various kinds of work by turning on and off the current—obviously a crude and time-consuming method.

Telephone Service of Lincoln Highway Motorist.— In order that the motorists traveling on the Lincoln Highway may be in constant touch with garages and communities along the route, it is planned to run a double-copper telephone wire along the highway from Salt Lake City to Ely, and thence to Reno. The plan also calls for cut-in stations at intervals of about 1 mile, so that in no instance will a traveler be stranded further than a half mile from the nearest telephone station, from which he can call for relief. Telephone instruments will be furnished to travelers at either end of the route upon payment of a small deposit.

Electric Motor for Phonographs.— No longer is it necessary for owners of the conventional phonographs to crank the mechanism in order to play the records, for there has recently been introduced a small electric motor that can be instantly applied to any disk type phonograph. The motor weighs about three pounds and is made to operate on either direct or alternating current. It is provided with a rubber disk which makes a friction contact with the periphery of the phonograph turntable. With the exception of removing the crank handle, no other change is necessary in converting a phonograph into an electric one, using the small motor.

Consumption of Current for Heating Homes.— According to the *Electrical World*, electric heating has been seriously tried in a great many places in Norway, and reports made by a royal commission indicate that a pleasant, even temperature is possible with an expenditure of from 30 watts to 35 watts per cubic meter of space—35 cubic feet. This will keep the temperature of a room at 64 deg. Fahr. with auxiliary heating when the thermometer registers as low as from 10 to 5 deg. Fahr. Under these circumstances electric heating is assumed to be cheaper than other fuel when the energy can be supplied at $7 to $8.25 per horse-power per annum on maximum demand.

A Non-Carbonizing Insulator.— What promises to be of utmost importance in the field of electrical apparatus is the invention of a non-carbonizing insulator by John F. Green, of Pittsburgh, Pa. After several years of study the inventor has succeeded in eliminating ferrous oxide and free magnesia from asbestos, producing a quartz insulator designated as Fibrous Quartz or De Ferroized Asbestos, which is claimed to be absolutely non-carbonizing. The material can be made into any required form. At a temperature of approximately 7,500 deg. it melts and runs not unlike molten steel. Experts who have examined the new insulation proclaim it immune to heat and most promising as an insulating material.

A Dry Storage Battery of the same size and shape as the ordinary dry cell is an offering of an American manufacturer. The new storage battery contains a non-flowing electrolyte and, according to the statements of the manufacturer, can be recharged an infinite number of times at a lower price per charge than the original cost of an ordinary dry cell. The rating of the battery is 0.5 ampere for 40 hours, I ampere for 18 hours, 2 amperes for eight hours, or 3 amperes for five hours. The average discharge potential is 2 volts. The container of the battery is made of unbreakable paper-fibre, while the elements are of rolled strips of corrugated lead. The electrolyte is contained in an amorphous, non-crystallizing white substance which is claimed to possess exceptionally high absorbing power. A tube is provided in the center of the cell for carrying water in order to prevent the cell from drying out.

Science

Kite Photographs of a Volcano.—A series of remarkable photographs of the crater of Kilauea, Hawaii, have, according to *Science*, been obtained by Mr. C. F. Haworth by means of kites during the past six months. The primary object of taking these pictures was to secure additional data for use in the construction of the large naturalistic model of Kilauea that has been under way for the past three years for the geological department of Harvard University.

Effects of Strychnine Sulphate on Quail.— On account of the plague infection existing among California ground squirrels, the U. S. Public Health Service has been co-öperating for some years with the California State Board of Health in efforts to exterminate these animals. One method of destruction is distributing barley, poisoned with strychnine sulphate, over the infected lands during the dry season. The question has, however, been raised whether this procedure might not work havoc among the California Valley quail, and in order to obtain information on the subject, as requested by the state game and fish commission, tests were recently made at the Federal laboratory in San Francisco. The results were entirely reassuring. It is found that quail may be fed, under natural conditions, relatively large amounts of strychnine sulphate without showing toxic symptoms, while the California ground squirrel is extremely susceptible to the effects of the same drug.

The North Magnetic Pole.—The late Dr. Aksel Steen, director of the Norwegian meterological service, had charge of working up the magnetic observations made by Amundsen on his Northwest Passage of some years ago. *Terrestrial Magnetism* publishes a letter written by Dr. Steen, shortly before his death last May, stating that two or three years more would be required to complete the work. The writer declares that it will be impossible to give a definite position for the north magnetic pole, because, in his opinion, this pole "is not a fixed point attached to a certain geographical latitude and longitude, but must be defined as that point on the surface of the earth where the horizontal intensity at the moment is zero." The discussion of Amundsen's observations will probably show that the pole has a mean daily and yearly periodic motion, together with more or less irregular displacements. A mean position for the pole can perhaps be determined, or else it may be possible to define a closed curve within which the pole will always be found.

Climatic Subdivisions of the United States are discussed by Prof. R. De C. Ward, of Harvard University, in the current *Bulletin* of the American Geographical Society. The classification of climates and the delimitation of climatic provinces is a difficult problem, at best, and usually something of a makeshift. Various climatic subdivisions have been used in this country for various purposes. The state is a convenient though artificial unit. River basins have sometimes been used, in order that the meteorological data might be most readily applied to the problems of the hydrological engineer. The Weather Bureau, in its "Summaries of Climatological Data by Sections," has divided the country into 106 regions, determined partly by state lines and partly by other considerations. Prof. Ward now proposes a good broad subdivision into eight provinces, of which the "Eastern" is by far the largest, as it embraces approximately the eastern half of the country, exclusive of the tier of states along the Gulf, as far west as the middle of Texas, which constitute the "Gulf" province. The others are "Northern Plains," "Southern Plains," "Northern Plateau," "Southern Plateau," "Northern Pacific" and "Southern Pacific."

Loss of Weight of Musk in Dry Air.—Since the sensation of smell is supposed to be due to particles of the odorous substance carried by the air into the nose, it must be assumed that all odorous materials lose constantly in weight. Frequent attempts have been made to measure the loss of weight of musk, but with little success, and one still finds it stated in reference books that this substance gives off its odor for years without losing in weight at all. A very minute quantity of an odorous substance, however, can be detected by the nose; 1 part of musk in 10,000,000 of air, and 1 part of mercaptan in 50,000,000,000 of air according to Fischer and Penzoldt. This subject has been taken up anew by Dr. C. B. Bazzoni, who has made use of a special form of quartz micro-balance, installed in a glass case through which was drawn a current of chemically dried air. This installation prevented the progressive loss of weight of the solid substance from being masked by changes due to varying atmospheric humidity. 1.32245 milligrams of musk lost in 7 months 14 per cent of its weight. The rate of loss varied considerably from day to day, but was much greater in the first part of experiment than in the last, finally becoming almost *nil*. The musk was then removed from the case, and was found to have lost its odor. The odor was not restored by moistening, crushing or exposure to the open air.

Automobile Notes

Leaky Tire Valves.—There is nothing more exasperating than a tire valve that will not hold air in the tire. Fortunately these valves are usually very reliable, but they sometimes go wrong, and if a fresh set of interior fittings is not at hand a temporary expedient is to plug up the valve with a bit of soap, after the pressure has been pumped up. Another way is to use some chewing gum. These are old bicycle dodges, but equally as effective for an automobile.

License Qualifications in England.—A recent court case in England calls attention to the inadequate requirements for obtaining a license to drive a car in that country. A blind man was summoned for driving a car, not because he was blind, but merely that he had no license. This case calls attention to the fact that a blind man, a cripple, or an imbecile can obtain a license there if he can produce the necessary five shillings for the license fee.

Alleged Diseases of Autoists.—When the bicycle was in the limelight, and the daily papers would publish most anything connected with the subject that came to them, the doctors began to discover, or rather invent, many new and fearsome diseases that they claimed to result from riding the wheel. The doctors got their names into the papers, but the diseases never materialized. Now, some enterprising member of the medical fraternity has discovered a peculiar knee trouble that he claims to result from continued use of clutch and brake pedals. It will probably join "kyphosis-biclarum" in oblivion after it serves its purpose as a newspaper item.

Lubrication Troubles.—One of the most vital requirements about an automobile is adequate lubrication, and this includes not only the engine and transmission, but numerous other points where friction exists. It has long been appreciated that the old splash system was both crude and inadequate for the engine, and serious efforts are being made to perfect systems of automatic lubrication that will save the engine from the disasters that result from either the neglect or the ignorance of the non-mechanical user. But there are innumerable little spots around the controlling levers, brake rigging, springs, and what not that depend for their lubrication on a varied assortment of oil and grease cups that are carefully tucked away in unsuspected corners, where they escape discovery for months, and frequently are never found. This feature of automobile designing has been sadly neglected; and a simpler arrangement would be a strong talking point for the maker who evolves it.

British Post Office Uses Motors.—The dissatisfaction of the railroad companies in the United States with the payments made to them by the government for mail haulage, is as nothing compared to the attitude of the British railroad companies. The British post office department discovered that for short haulage, up to about 125 miles, the motor truck or tractor is far cheaper and better than the railway. For this reason the great bulk of British mail transfer over distances within 125 miles is now made with trucks. The railroads only are allowed to handle the "unprofitable end" of the mail haulage—the whole system resulting in a technical "profit" for the post office department. The contracts between the British government and the railroad companies provides for a flat rate, for both long and short haul, with the profitable operation on short hauls only. As, however, no provision was made in it for the installation of motor trucks by the department, the railroads are powerless to prevent this sharp practice, and must continue to haul mail at a loss for long distances.

New Storage Battery Helps.—The extraordinary increase of the use of electric starting and lighting systems for automobiles has brought electric storage batteries into the hands of more than half a million people who heretofore never had any occasion to use them and who really did not know their construction. The greater use of electric pleasure cars and trucks, too, has widened the field of the electric storage battery. A poorly charged battery is a cause of great inconvenience and it is usually the lack of definite knowledge of the battery's condition that is responsible for the trouble. A few of the latest simple instruments designed to prevent a misuse of storage batteries are the following:

A Hydrometer-Syringe—this is intended to show the strength of the battery by means of a hydrometer, inclosed in the glass part of a bulb syringe. The glass nozzle is inserted in the storage cell opening, filled with the liquid and the resulting specific gravity read on the hydrometer. 1,300 indicates fully charged; 1,275 is 75 per cent charged; 1,250 is 50 per cent charged; 1,225 is 25 per cent charged, and 1,200 exhausted.

A pocket thermometer for determining the temperature of the battery while charging. Its scale reads from 20 to 220 deg. Fahr.

A pure rubber bulb syringe for filling and equalizing the acid in storage batteries.

Voice-controlled Writing Machine

A New Phonetic Alphabet Based on Speech Characteristics of Sound

A NEW alphabet has been discovered. For years thousands of styluses have been tracing the strange characters right here in our very midst, but the writing has been so fine and so complicated that hitherto the letters have not been deciphered. We refer, of course, to the writing of the phonograph needle which spells out its record phonetically in cursive characters that are not arbitrary symbols, like those of man-made alphabets, but are definite forms fixed by laws of nature.

Three years ago, the SCIENTIFIC AMERICAN published a description of a voice-operated typewriter, which was then in a purely experimental stage, although it gave some promise of success. The inventor, Mr. John B. Flowers, had devised a system of reeds tuned to respond to various characteristics of speech. These, by means of electrical connections, were adapted to operate corresponding keys of a typewriter. If a simple word were spoken into the receiver of the apparatus, the keys would automatically respond and write the word.

While the vowel sounds were easily detected by the instrument, it was exceedingly difficult to distinguish the consonants, and when continued experiment failed to solve this knotty problem, the inventor came to the conclusion that he needed a more complete knowledge of the characteristics of human speech. Evidently, the difference between two speech sounds, such as "B" and "D," for instance, was not one of wave frequency. Variation in the number of sound waves would merely raise or lower the pitch, but the characteristic "B" and "D" sounds are distinguishable whether uttered by the highest soprano or the basso profundo. What then are the peculiar characteristics that enable us to distinguish the various letter sounds? This was the problem that Mr. Flowers set out to solve.

He realized early in his experiments, that speech is not dependent upon the vocal chords; for words may readily be distinguished if whispered. Hitherto, speech records have always been spoken aloud or sung, with the result that the curves traced have been complicated by fundamental tones and over-tones of the vocal chords, as well as the mouth tones. In order to get a pure curve, Mr. Flowers decided to make records of whispered speech. This he succeeded in doing by the use of an acousticon transmitter coupled to an Einthoven string galvanometer, in the manner shown in Fig. 6. A cross-section of the acousticon is also shown in this engraving, which shows how the sound waves are gathered by reflecting surfaces and projected with magnified intensity upon the diaphragm. The operation of the acousticon transmitter produces electrical vibrations corresponding to those of the voice. These vibrations are conducted through a fine silver-plated quartz thread one ten-thousandth of an inch thick. This passes between the poles of an electromagnet, and in response to the electrical variations the wire is compelled to vibrate. A beam of light shines upon the wire, and its shadow is cast upon a revolving drum fitted with a highly sensitive photographic film. By a system of lenses the slightest motion of the string is magnified nine hundred times on the film. The telephone receiver shown in the diagram was used as a check on the articulation of the words. In order to produce a time record, the light of the arc lamp was interrupted five hundred times per second, thus producing vertical lines on the film at intervals of 0.002 sec.

With this apparatus it was proved conclusively that it is the variation of intensity in sound waves that produces speech. For instance, the waves recorded by the sound "B" would vary in intensity according to the pattern shown in Fig. 1. If "B" were pronounced on a lower pitch, this pattern would be the same, but it would contain fewer waves, as in Fig. 2. The pattern usually lasts at least 0.001 second, when, if the sound continues, it repeats itself.

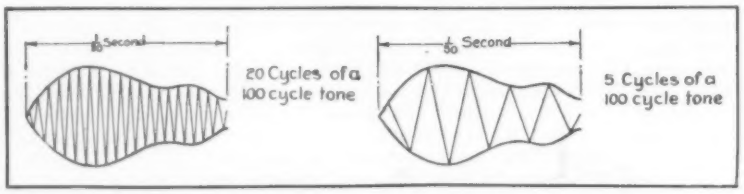


Fig. 1. Characteristic intensity curve of the "B" sound

Fig. 2. Intensity curve of sound "B" when uttered at a lower pitch

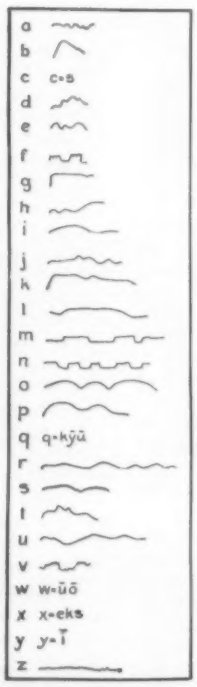


Fig. 3. The new phonetic alphabet

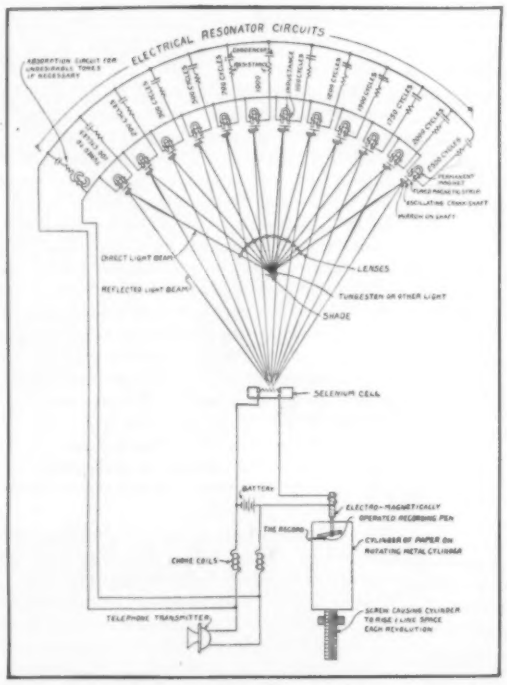


Fig. 4. Diagram of a voice-operated machine for recording speech in the new phonetic characters

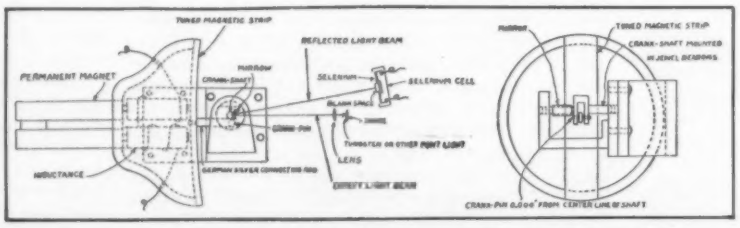


Fig. 5. Mechanical arrangement of the mirror-moving mechanism of the voice-operated writing machine

As shown in Fig. 5, this oscillates a tiny mirror, which throws a beam of light upon a selenium cell; normally the beam falls upon a blank part of the cell, but as the beam vibrates it illuminates more or less of the selenium on each side of this blank zone, producing a variation in the electrical resistance of the cell. An electrically-operated pencil bearing upon a cylinder of paper is controlled by the variations of resistance of the selenium cell, and thus a wavy line is drawn that records the speech in the new phonetic characters.

The reason for having a large number of electrical resonator circuits is to allow for variations of pitch. An average man's voice has a pitch lying between 85 and 160 vibrations per second, while a woman's voice will vary between 150 and 320 vibrations. The machine illustrated has not yet been built for all the various pitch cycles shown in the drawing, but it has been constructed to operate on a single pitch.

In use, a machine such as this, would produce a record that would have to be transcribed by a typist into Latin characters and English spelling. The record made by the machine is fully as easy to decipher as that of a siphon recorder used in cable telegraphy. Should such an instrument come into common use, the dictator would soon learn to read the natural phonetic writing, and it is conceivable that in time it might become unnecessary to transcribe the writing into Latin characters. The public would learn a new phonetic alphabet, and the problem of simplified spelling would be solved.

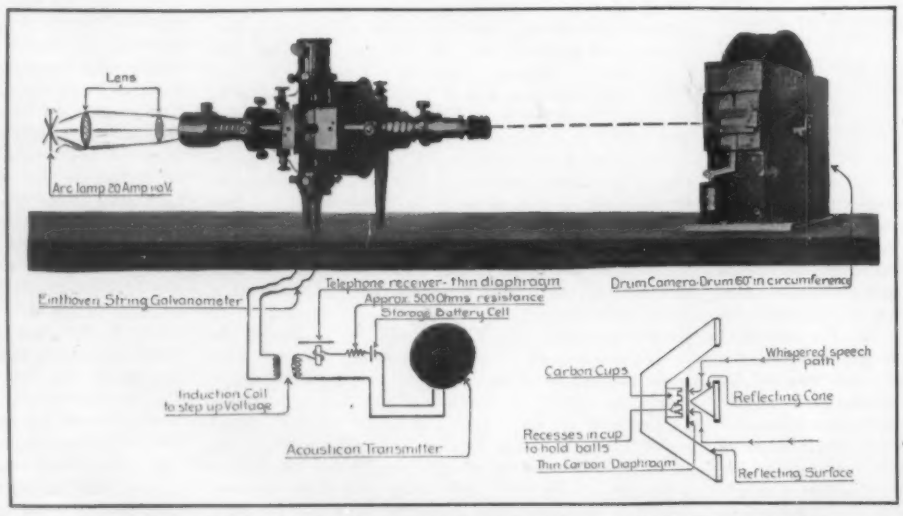


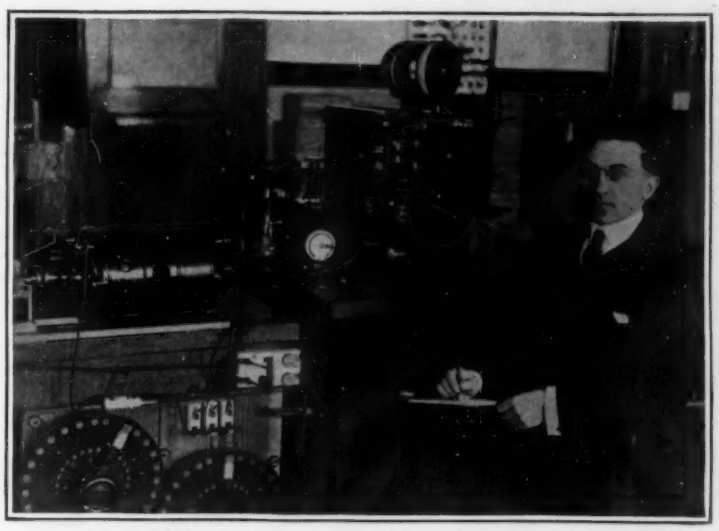
Fig. 6. Apparatus with which the characteristics of speech were studied. The insert shows a section of an acousticon

Radio Direction Finder Invented by Young American

IT is announced by the Department of Commerce that the Bureau of Standards has met with success in the developing of a satisfactory radio direction finder. Much interest centers about this device, since the possibility of locating accurately the source of wireless signals is of utmost importance not only to naval and military men, but also to the mercantile marine as a means of avoiding collisions. Furthermore, the direction finder apparatus is invaluable to the radio inspectors of the Bureau of Navigation for the locating of amateur and other stations that are not observing the radio regulations or are otherwise interfering with radio transmission of the Government and legitimate business.

The wireless experts of the Bureau of Standards, under the direction of Frederick Kolster, who, it will be recalled, has contributed materially to the progress of radio telegraphy, have been investigating the subject of wireless direction finding for some time past. The instrument, which they have developed as a result, is said to be simple and practical, and at the same time very efficient in operation. It indicates the direction of the source at the instant the signals are being received; and while it is very sensitive to radiations in a given direction, it is less affected by atmospheric disturbances and interfering radiations from other directions than an ordinary receiving apparatus. It is stated that messages have been received by one or another of the three sizes of instruments that have been built, from Philadelphia, Boston, Glace Bay, Newcastle (N. B.), New York, Norfolk, New Orleans, Panama, Key West, San Diego, and Hanover, Germany. When atmospheric disturbances have been very pronounced on the large antenna at the West Laboratory, they have been very slight on the direction finder apparatus, which is entirely indoors, having no antenna or earth or outside connection.

The new direction finder apparatus appears to be well adapted to use on merchant and naval ships to obtain the direction from any light houses or light ships that may be equipped with radio fog signaling apparatus; to obtain the direction of one ship from another at sea; to communicate between ships or ship and shore stations irrespective of direction by reducing interference and atmospherics; to use by the War Department in field service, as the receiving apparatus is portable and requires no ground or antenna, and can be carried readily in a light vehicle or even by a single observer; and to use by the Bureau of Navigation to locate amateur or other stations that are not operating their transmitting apparatus in compliance with the radio regulations.



Frederick Kolster of the Bureau of Standards, and the new radio direction finder apparatus

Railroad Wheels That Are Practically Silent

DESPITE the number of attempts made in the past to produce a really silent wheel for railroads and trolley cars, no successful wheel of this type has been generally adopted by the railroad companies. In the course of long-continued tests there always cropped out disadvantages which the inventor had overlooked in the design of his wheel.

At the present time, however, Eastern railroad officials are greatly interested in the performances of a new type of wheel, which has been undergoing the most strenuous tests and subjected to nearly a year of actual service.

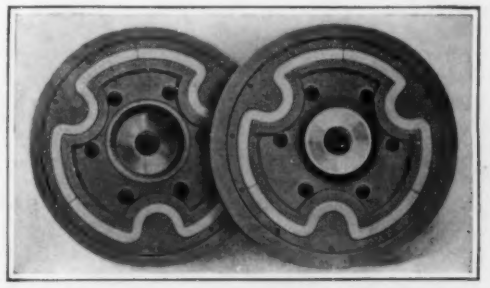
The tests to which the new wheel has been subjected have been carried on without undue publicity; in fact, without even the formality of advising the technical press of their purpose. It has been the intention of the inventor, as well as the railroad officials, to keep the matter private until the full year trial is over. At the end of this time, provided the wheel has shown its many advantages to the satisfaction of the railroads, it is to be manufactured in quantities.

The writer was informed of the object of these tests in October, 1915, and after some difficulty succeeded in obtaining a short technical description of the wheel and some photographs of the first two sets made. Since April 8th, these wheels have been in continuous use on one of the trolley cars in Portland, Me., and a complete daily record is kept of the performance. During the first six months of the strenuous test the wheel proved so satisfactory that a large order is now being arranged for, while a plant is to be erected for the manufacture of the wheel in large quantities.

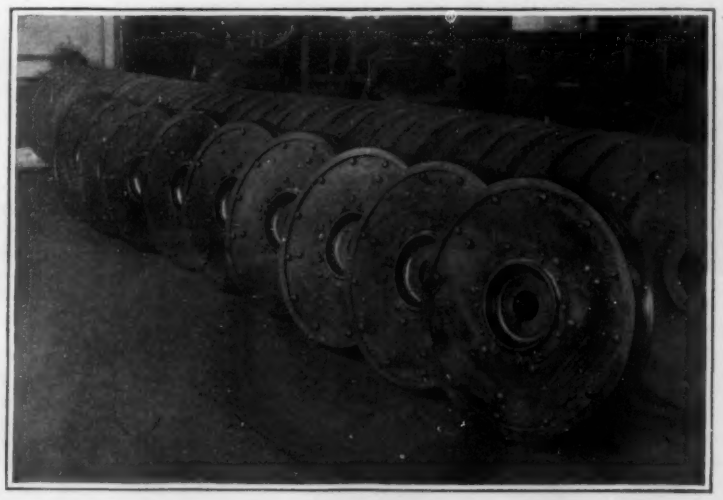
The new wheel, as will be seen in the accompanying illustrations, consists of two distinct wheels—a wheel within a wheel—separated from each other by an irregular cushion of rubber. The shape of this cushion represents the results of innumerable tests with shock absorbing devices. It absolutely prevents both forward and backward creeping, it is claimed, without the use of lugs or bolts. In actual use, of course, the sides of the wheel are protected against dirt, dust, and damage by steel plates, while the rubber cushion is prevented from moving laterally by the same disks.

Among the advantages claimed by the inventor, and so far borne out by the tests made in Portland, are the following: First, several times the tire service of an ordinary cast-iron wheel; second, tires are easily removed and renewed; third, wear of the cushion proper is estimated at four years on average trolley service; fourth, steam railroad tests indicate its good influence on the rolling stock, rails, and switches, which are subjected to much smaller shocks; fifth, on city and interurban trolley lines the question of excessive noise is solved to the satisfaction of residents along the routes; sixth, greatly improved riding qualities of the cars and greater comfort for the passengers.

In order to forestall the incorporation of any possible defects in the wheels when these are to be placed on the market, the inventor has resolutely refused to accept definite orders until the tests in Portland are completed. In the meantime, residents along the line on which the "silent" car is operating are highly pleased and interested, while the railroad officials look on with increasing approval. They estimate the life of one of these silent wheels at 300,000 miles of actual travel. Tires and inner cushions are renewed at small expense whenever new ones become necessary.



Interior view of the silent wheel with both cover disks removed, showing the shock-absorbing cushion



Outside view of a group of Madden silent railroad wheels, with the steel side disks in place

Edwin C. Madden, the inventor of this wheel, was Assistant Postmaster-General under the McKinley Administration, and is the originator of the little stamp booklets now sold throughout the United States to the public, incidently making a profit of about $150,000 a year for the Post Office Department.

The Solar Constant of Radiation

THE June issue of the *Proceedings* of the National Academy of Sciences contains a note on the solar constant of radiation by C. G. Abbot, F. E. Fowle, and L. B. Aldrich, who made nearly one thousand determinations of the solar constant between the years 1908 and 1914. The observations were made at Washington (at sea level), Bassour in Algeria (1,160 meters above sea level), Mount Wilson, California (1,780 meters), and Mount Whitney, California (4,420 meters).

Langley's spectro-bolometric method was employed, at the atmospheric absorption being computed from measurements of the distribution of energy in the solar spectrum at different zenith distances. The bolometric measurements were reduced to calories by daily comparisons with standardized pyrheliometers. The mean value found is 1.93 calories per square centimeter per minute.

The close agreement of the values found at different times and places, although both the direct measurements and the computed atmospheric absorption were greatly affected by differences in temperature, barometric pressure, humidity and haziness, seems to be strong evidence of the soundness of the method.

Furthermore, the atmospheric transmission coefficients obtained at Mount Wilson agree well with Rayleigh's theory of atmospheric scattering. From these coefficients Fowle has computed the number of molecules per cubic centimeter of air as 2.70×10^{19}, which is very close to Millikan's value (2.705×10^{19}), obtained by absolutely independent methods.

Another evidence of the soundness of the work is the fact that simultaneous observations at Mount Wilson and Bassour agree in showing an irregular variability in solar radiation, which has recently been confirmed by measurements of the distribution of brightness along the sun's diameter.

Nevertheless, it has been objected that 1.93 is much too low a value for the solar constant, that higher values have been obtained for the uncorrected solar radiation on mountains and from free balloons, and that the correction made for atmospheric absorption was too small because no observations were made within 15 deg. of the horizon.

In order to meet these objections, observations were made at Mount Wilson from sunrise until 10 o'clock, on September 20th and 21st, 1914. On both days the atmospheric transparency remained sensibly unaltered. The values found for the solar constant fall between 1.90 and 1.95.

In July, 1914, a recording pyrheliometer was raised by sounding balloons to an altitude of about fifteen miles, where the barometric pressure was one-twenty-fifth of the pressure at sea level. The mean value of the best records of solar radiation thus obtained at highest altitudes is 1.84 calories per square centimeter per minute. The highest reliable direct observations of solar radiation range from this value downward to 1.58, made at the sea level, at Washington.

Germany's Substitute for Cotton

GERMANY'S supply of cotton, so necessary for the manufacture of modern high explosives, is low enough that a diligent search is being made for adequate substitutes. England has cut off the foreign supply and thousands of tons are demanded for comparatively short campaigns.

So far the hope has been that cellulose from some special wood might be nitrated successfully into gun-cotton, but that success has not yet been reported. A measure of success in getting a substitute has been obtained, however, in using certain forms of paper pulp, lignin, etc., as a dressing for wounds, thus saving some of their precious cotton for explosives. One firm in Berlin is selling "Lignin" as an absorbent for blood at a price of about eight cents per pound in hundred pound lots. It is put up in sheets about fourteen by twenty-four inches and in packages of eight pounds or rolls of two pounds.

One of the most effective wound dressings among these substitutes is sphagnum moss which to some extent had been used in both England and Germany before the war. The moss is so full of minute tubes that in its ordinary state it holds nine times its own weight of water and is therefore a powerful absorbent when dry. It is very soft and light. Gathered from the swamps, it is dried on rocks or bushes until bleached white, then cleaned and sterilized.

Strategic Moves of the War, February 4th, 1916

By Our Military Expert

IT is a long jump from Macedonia to the western battle lines and the recently initiated Teutonic offensive in that locality, but there evidently exists a close relationship between the two.

Ever since the Entente gains in the autumn of 1915 when the Germans barely were able to check an advance of moment, Teutonia has maintained a very tenuous foothold on the ends of the ridges that extend from the Channel to various points on the battle front north of the Oise. Fighting on a hilltop with the slope behind the defensive line is no sinecure and is fraught with disastrous possibilities should the defense fail to hold. At several points the Germans were forced back until their trenches teetered precariously on the hills—and they had not sufficient strength available at the moment to launch a counter attack with an ample weight to give promise of recovering the lost territory. Almost every possible battalion had been stripped from this front to engage on the eastern line and in the Balkans. At the same time, the advantage of the defensive proved so great that Germany could hold off her assailants at the last moment and prevent their breaking through.

The general situation, and especially the necessity for securing a toe-hold at Saloniki for a future day, required the reinforcing of the Entente position at this point, thereby taking away troops that might otherwise have secured a local victory at the expense of giving up the hold on the Grecian port.

A glance at the map shows the general position in France to be that of a huge, rough salient. The very existence of such a salient is a menace in itself. It is evident, then, that the constant activity on the side between the Oise and Flanders, as well as that on the other between Rheims and Verdun, a constant pecking and striving, means much. There has been comparatively little activity at the blunted apex. The western line, in acknowledgedly superior Entente strength, has seemed comparatively calm in proportion to its power; the oft-heralded general offensive has been lacking; movements which seemed to presage such an undertaking petered out into mere local activities.

Yet, both Entente and Teutonia know that it is certainly coming eventually. The latest German strokes, therefore, undoubtedly constitute an effort to secure a better local position for various sectors of defense against the breaking of the gathering storm.

When the offensive develops it will logically move eastward against the northern leg of the salient and northward through the Champaign district. Both ways lie thickly strewn with fields of defense, obstacles and myriad trenches backed by hundreds of guns. The very trenches and faults of the ground must run crimson before such attacks win through; the cost in men will be so appalling that the civilized world will gasp when the full story is told. Yet this sanguinary assault must be made—unless something collapses within the Central Empires.

But, if successful, if sufficient strength is marshaled to carry home these thrusts, the intervening territory embracing Laon, St. Quentin and Cambrai will form a great cul-de-sac in which enormous Teutonic forces and material should be bagged unless peril of the position is realized in time to permit them to make a withdrawal.

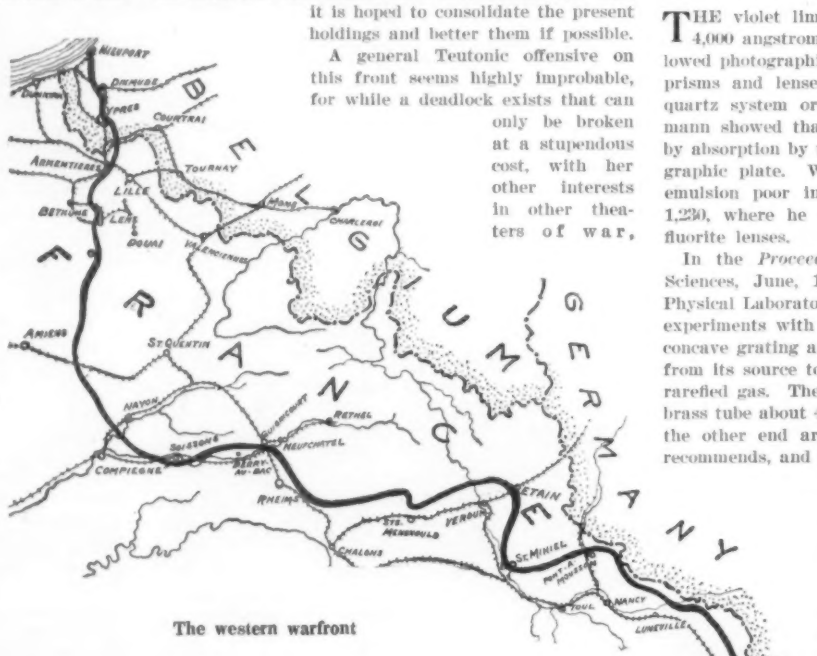
Beyond the shadow of a doubt, should such a success come to pass, French territory would at once be cleared of invaders, and Germany would then be compelled to fall back along the whole line, probably resulting also in the accompanying clearing of at least a part of Belgium.

The public has grown so accustomed to measuring gains and losses on this line in terms of yards, that the resulting gain of ground from a successful piercing of the sides of the salient would probably appear as a decisive victory with its reacquisition of hundreds of square miles at a blow. That would be a mistake, for then the Teutonic line would have become automatically straightened and shortened, have been brought closer to points of supply and have been forced back only to stronger positions of defense, the further back the stronger fortifications upon which to rest the line. And the whole thing would have to be done again. It is almost inconceivable under existing conditions, even should Germany be compelled to evacuate French territory and Belgium, that the Entente could easily continue an offensive to pierce through to Germany; the war is to be won, if it is won within the year or so, through coöperation, blockade by land and sea, loss of morale by Teutonia, and through diplomacy, not merely by force of arms. Local successes, general successes, are desired and needed by the Entente, but the material gain will be found to lie in the tightening of the bonds more than in an actual storming of interior fortified lines. They are too strong.

This is not intended as prophecy, for it is but outlining succeeding probabilities founded upon the ground, the position, its extent and general contour, the measure of local activities, the estimated strength of the contending forces, the general situation, the obscurity of Entente preponderant force, and the fact that should the Entente consent to a cessation of hostilities, with Teutonia occupying her present advanced holdings, the Kaiser would have won his war, hands down—a something utterly incompatible with existing resources in men, money and munitions possessed by his enemies.

Now that Germanic forces have been released from immediate activity in the Balkans they are available for a shift to the eastern or western line, and the recent offensive serves to suggest that for the time being the latter has been chosen for a first venture by which it is hoped to consolidate the present holdings and better them if possible.

A general Teutonic offensive on this front seems highly improbable, for while a deadlock exists that can only be broken at a stupendous cost, with her other interests in other theaters of war, Germany is not believed to have sufficient forces available to undertake it without actually stripping other defenses for the task, a measure which even the desperation of a genius aided by Germany's wonderful railway system could not dare. It is clear that both eastern and western lines are well balanced in immobility; if the balance should be materially deranged by removal of troops, it would promptly sway under the rush of force quick to take advantage of such an opportunity—waiting for it, in fact—in strength. It is at least four times harder to take new ground than to hold ground already possessed, and Germany can scarcely afford the cost of another general offensive. She is now constructively on the defensive, her advanced holdings guarded by a rim of steel of quadruple delineation; although necessity demands that she make good her footing wherever possible, to wait for developments and welcome any opportunity for peace—so long as she remains where she is.



The western warfront

When the Entente offensive is launched at last—it may be within a few weeks or it may be postponed until spring and summer are blending—if it is to be endowed with the attributes of success, activity must be displayed by its allies on every front. Russia must throw her reorganized legions forward in hopes of successes—in any event, to cause the retention of powerful force against her that it may not be shifted. Macedonia must again become a field of battle, more terrible, more complex than ever before. And the French front must blossom into flame from Nieuport in Flanders to the "Last Post," near the Swiss frontier, while the mighty attacks are launched upon the enormous salient.

It takes a great deal of time to prepare for such an assault. Not only on the actual front to be stormed, but on all others—shells, shells, shells, must be up and ready for every available battery; and line after line of men must be in position to sweep forward, to be deliberately sacrificed that their following fellows may gain ground, opposed by steadily lessened strength through the degree of punishment inflicted by those sacrificed before they fell.

The French, dominant factors on the western line, have waited wisely, content to let their opponent wear down by fruitless beating on the bars while they and their allies prepared. France was *not* ready for war when it came, England was grossly unprepared, and it has taken every bit of the time intervening until the present to gird their loins.

It would seem as though the Entente should be ready at last; but a little further time of preparation must ensue through the state of the ground, which is muddy and slippery, for the winter has not so far been a severe one. The first spell of warm weather that will dry things up should witness a rustle of preparation, the shifting of troops at night, the massing of guns under concealment and the concentration of munitions; for when a rush is to start across a fire-swept expanse of land, every second—fraction of a second—is of untold value, that the period of exposure before the bayonets lock breast to breast may be cut down to a minimum.

The Extension of the Spectrum Beyond the Schumann Region

THE violet limit of the visible spectrum is about 4,000 angstrom units, but the spectrum may be followed photographically to wave-length 3,000 with glass prisms and lenses, and to wave-length 1,850 with a quartz system or a reflecting grating. Victor Schumann showed that this limit (1,850) was determined by absorption by the air and the gelatine of the photographic plate. With a vacuum spectroscope and an emulsion poor in gelatin he reached a wave-length 1,230, where he was stopped by the opacity of his fluorite lenses.

In the *Proceedings* of the National Academy of Sciences, June, 1915, Theodore Lyman of Jefferson Physical Laboratory, Harvard University, describes his experiments with a vacuum spectroscope containing a concave grating arranged so that the path of the light from its source to the photographic plate is wholly in rarefied gas. The grating is mounted at one end of a brass tube about 40 inches long and 4 inches wide. At the other end are the plate, prepared as Schumann recommends, and a slit admitting light generated electrically between tungsten electrodes in a quartz tube which communicates freely with the air-tight brass tube.

In the earlier experiments with a strong disruptive discharge in hydrogen at 2 or 3 millimeters pressure the spectrum was extended to wave-length 900. In later experiments with helium free from nitrogen the limit was extended to wave-length 600.

Three hydrogen lines, predicted by Ritz on theoretical grounds, were found at 1,216, 1,026, and 972. With pure hydrogen they are best seen with a disruptive discharge, but an alternating discharge of 60 cycles produces them in helium containing that trace of hydrogen so difficult to remove. The disruptive discharge is required to produce the seven or eight new helium lines of wave-lengths less than 900.

The limit now reached is set by the adjustment and dimensions of the apparatus, and Lyman sees no insuperable difficulty in further extension. A considerable region remains for exploration between 600 and 1 angstrom unit, which is the wave-length of X-rays, as determined by the Braggs.

The World's Forests

DESPITE the warnings of economists concerning wasteful deforestation, particularly in our own country, it appears from recent investigations that a goodly portion of the earth's surface is still heavily wooded. According to the *Naturwissenschaftliche Umschau* (Berlin) the world's forests are divided as follows:

The American Continent	646,752,000	hectares
Asia	370,000,000	"
Europe	314,500,000	"
Africa	230,000,000	"
Australia and Oceanica	95,000,000	"

The most notable fact is that out of this billion and a half of hectares of forest land, Europe should possess a share so relatively large, considering her area.

Industrial Preparedness for Peace

The American Declaration of Economic Independence

By Prof. Thomas H. Norton, Ph.D., Sc.D.

Bureau of Foreign and Domestic Commerce, Washington.

THERE is a note of preparedness in the air. The word is on every tongue from the Atlantic to the Pacific. To meet it means adequate preparation against any possible menace to our political and national independence coming from across the waters which wash our eastern and western coasts.

To our financiers, our economists, our captains of industry, it implies much more. It denotes timely provision for the vaguely defined changes which we all feel must inevitably follow the conclusion of the terrific struggle now raging over Europe, and profoundly affecting Asia and Africa.

The Europe of 1920 may show little resemblance to the Europe of 1913, politically or industrially, in ideals or in activities. The America of 1920 may be affected in a less degree, but unquestionably we shall have advanced far in the evolution of our national existence, accomplishing in years what otherwise might have required decades.

Half revealed to our vision is a nation financially as independent as it now is politically, the banker of the Western Hemisphere—possibly of the world! The initial steps are taken to create an American mercantile marine, able relatively to make our flag as familiar in the ports of the world, as in 1860, when our white-winged fleet traversed every highway of the oceans.

Simultaneously with the swift evolution of world-wide plans in finance and transportation, has come the conviction that the golden opportunity is at hand—within our grasp—to make this United States of America industrially independent, to free it from every shackle other than those rigorously imposed by climate or the geographical distribution of mineral resources.

These past eighteen months of warfare on a gigantic scale, hitherto unknown in the history of this globe, have taught us many lessons. The need of more adequate provision against an invasion of our territory is one lesson. It is, however, of minor importance compared with the great economic lesson, conveyed to us each passing day, while vast waves of conflict slowly, painfully, horribly ebb and flow.

The organized productive activities of this land, agricultural and industrial, are gradually forming the iron resolve, that never again shall they be exposed to the anxiety, the uncertainty, the loss, resultant from widespread dependence upon foreign sources for a multitude of products vitally essential to the very continuance of scores of gainful occupations. The lesson has come suddenly and brusquely—like a blow in the face. Time is required for its application; but on every hand are evidences that it has been well-learned.

As the outcome of private initiative largely, but occasionally as a result of combined effort, one after another, industries are being planted upon our soil which are destined to release us from further economic dependence upon European manufacturers for a large number of the most varied articles. The instances are multiplied daily. Individually they scarcely awaken public attention. In the aggregate they present a remarkable testimony to the keen and alert manner in which American enterprise and technical skill take advantage of sudden and unexpected opportunities.

In a somewhat more genial, but equally resolute manner, the American industrial of 1916 is issuing an economic Declaration of Independence, worthy to be ranked alongside the political Declaration of his great-grandfathers of 1776, some 140 years ago.

Noteworthy and instructive are the concrete examples of the manner in which this Declaration assumes form. Space does not permit the mention of more than a few of the interesting examples of new branches of manufacture, suddenly but still in a thrifty, enduring manner, called into existence during the past year and a half, displacing permanently in our domestic consumption wares to the value of many millions, hitherto imported from Europe.

Our knit goods industry has developed steadily of late years, but for many specialized forms we have been dependent upon the factories of Saxony. The annual imports of these articles amounted before the war to $2,200,000. We are now supplying fully our own needs in this line; and furthermore, our mills are now shipping annually knit-goods worth $16,240,000 to other countries. A year ago this export amounted to $2,547,000. Similar cases may be cited from other textile branches.

The curved faces of our watches and clocks came to us, formerly, exclusively from the glass works of Thuringia. The imports suddenly ceased in the autumn of 1914. Manufacturers of timepieces laid their needs before leading American glass makers. Within a month the problem was solved. The curved disks were made a regular article of manufacture. Their quality was beyond criticism. A second month passed, and the cost of production sank below the former current prices of the foreign makers.

The paper trade offers some interesting examples of the process of emancipation, now in progress. Lately we expended $1,350,000 annually in Germany for lithographic labels. The domestic demand is now met entirely by wares made in American mills. Fancy and surface-coated paper, brought from Germany, cost us annually $2,150,000. This, also, is now made entirely in our own mills. Our countless souvenir postals came also largely from Germany. We sent $420,000 each year across the ocean to pay for them. Now they are likewise supplied by American factories. Photographic paper from Germany cost us annually $720,000. That, too, is now all made at home, to the relief of every amateur and professional photographer.

Two years ago we expended nearly $1,800,000 for German toys. There was no lack observable when Santa Claus distributed his bounty last Christmas Eve. He however, filled his bag to the utmost limit, for once, with the products of American taste, ingenuity and adaptation to juvenile needs. In the future he will load his reindeer sleigh with wares from the same source. Among the varied supplies of the marvelous sleigh were bon-bons of foreign origin. We imported annually German confectionery to the value of $150,000. Last Christmas the palates of Young America were amply satisfied with the homemade product, and that will be the case in the future.

Many a child was delighted at Christmas by his first box of colors. He may not have noticed particularly the dainty soft brush with which they are applied. There was consternation, however, fifteen months ago, among his elders, gaining as artists their livelihood, for whom the brush is an indispensable tool. Germany was the sole place of manufacture and there was a total cessation in shipments. Promptly an American firm, specializing in artists' supplies, took up this branch. Incidentally it was found that the essential raw material consisted of fine hairs, from the inside of the ears of cattle; and further that the material came from the slaughter houses of Chicago. The steers of our Western plains will henceforth contribute their quota to American artistic activity, without being forced to make a double trip across the Atlantic.

Of the smaller musical instruments, we have hitherto imported from abroad articles valued at nearly $1,500,000 or about one third of the domestic consumption. These purchases from music-loving Germany have long since ceased, and the American manufacturers are now fully meeting current demands.

Despite the recognized excellence of American steel, we have imported annually from Germany, cutlery valued at $1,000,000. This export, also, has ceased, and American knives, razors and scissors are fully satisfying American needs.

Our domestic output of paints, and pigments is very large. Our yearly import of wares in this category from Germany has, however, exceeded $1,000,000. This item is, likewise, replaced now by colors made in American works.

The glove industry offers an admirable illustration of how quickly a domestic branch of manufacture can emancipate itself from foreign dependence. Until recently we purchased annually from Germany glove leather valued at $1,750,000, and leather gloves valued at $4,200,000. There is no lack of such gloves in our stores this Winter. They are, however, made in American factories, from raw material prepared in American tanneries.

And so I might pass in review a number of industries, dependent ordinarily upon European sources for semi-manufactured material or for important categories of finished goods ready for consumption. The pendulum has steadily swung to the Occident. Individual items represent values of a few hundred thousand dollars, or one to five millions. The aggregate is imposing. It means an industrial Hegira, without counterpart in the economic annals of the world; a reproduction to the nth degree of that flight of Gallic skill and inventive power to British shores, consequent upon another epoch of blood and carnage, ushered in by the night of St. Bartholomew.

All students of history know to what an extent British predominance in textile manufacture and in many other branches was due to the results flowing from that deplorable outburst of religious and political fanaticism.

A similar black-bordered page in the records of European civilization is being painfully penned in letters of blood. For the citizens of this country, saved by geographic conditions from being drawn into the maelstrom of jealousy, ambition and passionate struggle, it spells OPPORTUNITY in blazing letters. Before us is the opportunity to achieve industrial freedom, without laying ourselves open to the accusation that, in the midst of the peaceful, regular exchange of international products, there has been any deliberate attempt to cripple or kill a foreign industry, dependent largely upon its American market.

Under ordinary circumstances we possess legally the right to build up our domestic industries, even at the expense of foreign competitors. Under the existing circumstances of the long drawn out contest for life or death, between the European powers, with no apparent date for a conclusion of the titanic struggle, involving a progressive destruction of productive equipment and the machinery of commerce, it is not only a legal right, but an ethical duty, an exercise of the highest patriotism, following an elementary law of self-preservation, to save our economic fabric from threatened dislocation and anemia, by the prompt creation upon American soil of the requisite industries, in such form as to adequately and permanently insure the nation's material life from all danger, actual and prospective.

I have purposely reserved until the close any reference to the most important field in which this movement towards emancipation is making itself powerfully and noticeably felt.

In no province of applied science has the United States, in common with the rest of the world, been so largely dependent upon foreign manufacture as in the case of chemical technology. In producing a few leading staples, soda, sulphuric, muriatic and nitric acids, explosives, the alums, acid phosphate, copperas, blue vitriol, etc., we had reached the point where the country's ordinary demand was met by the domestic output. For the great mass of chemical products we were obliged to seek foreign sources, chiefly in Germany. There are few industries not dependent upon a varied supply of chemicals. Our agricultural interests were forced to import Chile saltpeter for their nitrates and turned to the mines of Stassfurt for their potash. The colors for our vast textile industry, with an annual output worth $1,640,000, our leather, paper, ink, paint and varnish branches, with a total output valued at $1,550,000, and scores of minor industries, originated chiefly in Germany. The complete list would be of great length.

The problem here is one of enormous difficulty, resultant from the bewildering complexity of chemical industry as a whole, and to an exceptional degree in the case of the coal-tar branch. It is, however, being resolutely tackled, and the victory is fairly in sight.

In the case of barium compounds, of oxalic acid, of the ferro cyanides, of sodium, of the peroxides, and several other categories, in part the requisite plants have been created and the full demand of the country will soon be met.

The coal-tar chemical industry offers the most serious difficulties, and makes the heaviest demands on capital and enterprise, as well as on technical and scientific attainments. Note, however, what has been done during the 18 months since the European war began.*

The output of the so-called coal-tar "crudes," benzol, toluol, xylol, phenol, napthalene, etc., from American coke plants, gas works and tar distilleries, for the entire calendar year, 1914, was about 14,400 short tons. The *monthly* output of these products at present is about 33,000 tons. (This includes 10,000 tons of synthetic phenol. The 8,500 tons of benzol required in its preparation should therefore be deducted from the above figure, leaving a net total of 24,500 tons.)

During the year 1914 we manufactured less than 900 short tons of aniline, and imported 1,500 tons. Today twelve American firms are manufacturing this fundamental intermediate for the production of finished dyestuffs, at the rate annually of 10,500 tons. These firms are manufacturing, also, 2,600 tons of other non-tinctorial derivatives of benzol.

During the year 1913 we consumed 29,000 short tons

(*Concluded on page* 184.)

* A very full study of all the factors connected with the establishment of a comprehensive, self-contained American coal-tar chemical industry appeared in the SCIENTIFIC AMERICAN for November 6th and 13th, 1915.

The Stored Energy of the Submarine

The Silent Power That Has Made Under-water Navigation Possible

ALTHOUGH the idea of under-water attack dates back to the Revolutionary War, it was not until the storage battery was perfected that the submarine became a practical weapon of war. No matter how formidable in attack the submarine may be, in defense it is the most helpless little craft imaginable. The barest touch of a ship's keel will rip open its thin shell and send it to the bottom. Its only refuge is the sea under whose cloak it may lurk in wait for the enemy, and in whose depths it may hide after it has hurled its bolt. It can live only by stealth, and so, in order to steal through the water without awakening a suspicion of its presence, it must be equipped with propelling power that is absolutely noiseless and leaves no visible trace of its operation. The storage battery and the motor it energizes are almost ideally suited to the requirements of the submarine; for they are silent and practically heatless, leaving no trail of bubbles to betray the whereabouts of the submerged vessel.

Needless to say, the submarine calls for a special type of accumulator, and it is a giant compared to the batteries seen in the common walks of life. Some idea of the size of battery required in our large new submarines may be had from the accompanying sketch. The battery consists of two units of 60 cells each and the space occupied by each unit is about 12 feet long by 12 feet wide and 50 inches high. The two units are usually separated by a bulkhead, but, combined, they are long enough to reach across a city lot. A complete battery of two units will weigh between 60 and 70 tons and their capacity will be approximately 3,000 amperes for one hour. These dimensions and weights refer, of course, to the lead type battery, which is almost universally used. It may be interesting to note that, of the 37 submarines in the United States Navy, 36 are equipped with lead type batteries and only one, the ill-fated "E-2," in which a disastrous explosion of hydrogen occurred the other day, is equipped with a nickel-iron battery. Of the 38 submarines now being constructed or authorized, 35 have been or are to be equipped with lead batteries and one is to be equipped with a nickel-iron battery, while contracts for the remaining two have not yet been let. In defense of the storage battery it may be said that no calamity has ever occurred on land or sea due to explosion or other effect of gas from a lead battery.

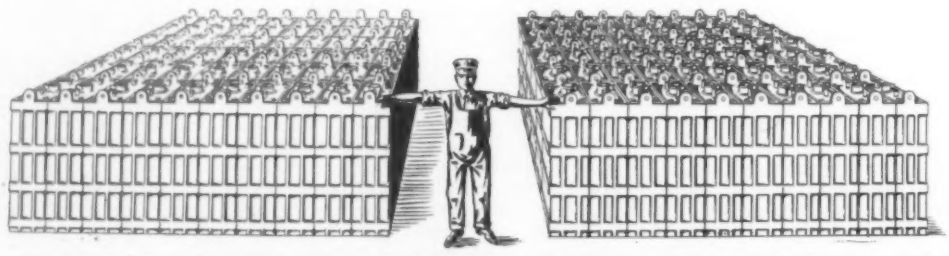
In the earlier days of the submarine it was not realized that a special form of battery was required for this use. At first the batteries were of the open type construction, that is, the individual cells had no covers. Now, submarine batteries are carefully sealed so that the electrolyte can never spill and so that salt water cannot enter the cell and come into contact with the sulphuric acid of the electrolyte and produce chlorine gas. In the latest type of battery, each individual cell is sealed. Unfortunately, it is impossible to seal a storage battery absolutely, for both in charging and discharging it generates hydrogen and oxygen gases. These must be carried off, and dissipated into the hold of the vessel. For this reason, separate air inlets and outlets are provided for each cell which connect with a ventilating duct equipped with an exhaust fan that draws off the gases. As the air passes out of the cell drawing with it the dilute gases it passes through a number of screens which remove from it all traces of the electrolyte.

The accompanying photographs have been taken in a factory which produces the majority of submarine batteries used by our Navy, and they show the construction of one of the latest types of batteries. A particularly novel feature is the formation of the positive plate. This consists of a series of rods or pencils of lead-antimony alloy, which are inserted in hard rubber tubes and are connected at the top and bottom to lead bars. The rods are provided with lugs which center them within the tubes and the tubes are filled with lead peroxide, which constitutes the active material. The hard rubber tubes are provided with thousands of fine horizontal saw cuts which are too narrow to permit the active material to pass through, and accumulate. This obviates one of the difficulties heretofore experienced in which the material was apt to fall to the bottom of the cell and accumulate in the form of a sediment, producing a short circuit.

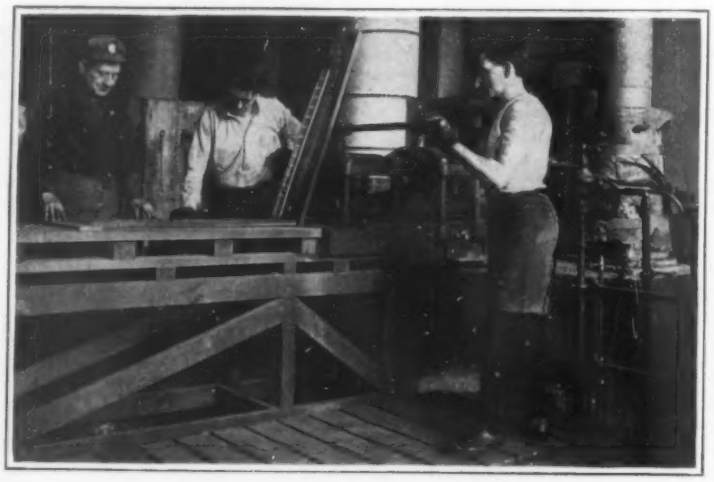
A special machine has been provided for sawing these tubes, which is shown in one of the photographs. A very fine circular saw is used which makes 660 cuts per foot. The machine is automatic in operation, feeding each tube step by step to the saw and leaving an unsawed space at each end of the tube. The pencils are cast in the form of a grid with their lower ends free, but the upper ones fast to the top bar. After the rubber tubes have been fitted upon the pencils the grid is passed to a special machine that fills the tubes with lead oxide. This machine is shown in one of the photographs, but the plate that is being filled is not of the submarine size, although the operation is exactly the same. The active material is in powdered form and it is shaken into the tubes by a violent jarring action which the operator can watch through a glass window. This done, a strip of lead is burned on the bottom of the pencils and the grid is then ready for the forming process.

The negative plate consists of lead grid filled with lead oxide paste. Thin sheets of wood, in some cases ribbed, and treated to remove all resinous material, serve as spacers between the plates. The container is made of hard rubber to eliminate the danger of short circuits and electrolysis should sea-water leak into the battery compartment.

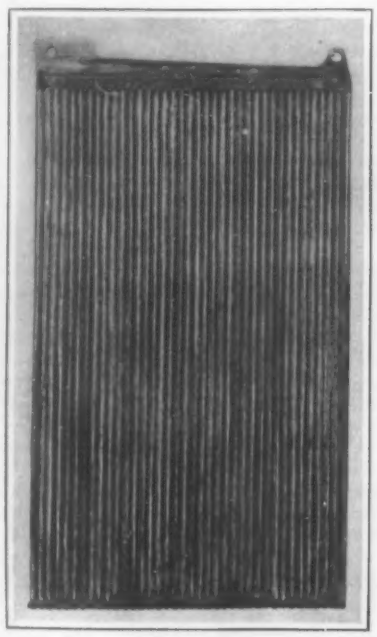
A special feature of the cell is the filling plug which is so arranged that the cell cannot be overfilled. The plug is removed by giving it a quarter turn which closes a valve that prevents overfilling. The water rises in the filling neck and thus indicates when sufficient water has been added. After the plug has been inserted again, no dust or impurities can get into the cell and even if the battery were submerged in salt water the water would have to stand several inches above the top of the cell before it could force its way into the electrolyte. Thus the danger of generating chlorine gas which has been made so much of in the daily press is practically non-existent.



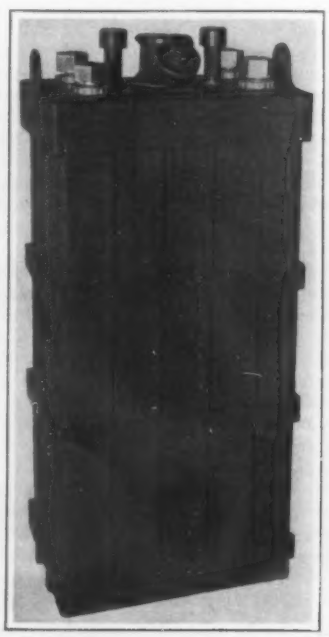
The storage battery for a modern, large submarine consists of about 120 cells, arranged in two units, each measuring 12 feet square by 50 inches high



How the grids are cast for the positive plate of the battery



The positive plate, showing the rubber tubes in which the active material is retained



Submarine storage battery cell about 50 inches high. Note how completely it is sealed

The negative plate, consisting of a lead grid filled with lead oxide paste

The Current Supplement

IN the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2093, for February 12th, 1916, there is an article on *The Inner Life of Some Common Plants* that tells of the chemical faculties of plants that are related to their growth, color activity, and other characteristics. *Surface Tension at the Interface Between Two Liquids* is a subject that will interest many. *A Differentiator* describes an ingenious new instrument that enables the engineer to lay out curves that are of great service in solving some of his problems. The construction and operation of this instrument is illustrated by several drawings and photographs. *A New System of Cutting Gears*

describes the so-called "ozoidal system," which is claimed to produce gears that run long and smoothly. *Ore Unloading on the Great Lakes* is a most interesting story, telling how the immense increase in the shipments of ore on our inland seas compelled the invention and development of ingenious machinery for the rapid handling of great quantities of material. A large number of photographs illustrate these wonderful machines that are equalled nowhere else in the world.

A matter of importance is *Trade-Marks in the American Republics*, which is a plea for the ratification of the Buenos Aires Convention of 1910.

The Open Hearth versus the Electric Furnace in the Manufacture of Commercial Steel gives facts and figures of considerable value. An *Anemometric Paradox* describes a curious windmill that always turns the same way no matter how the wind blows, and it is illustrated by an explanatory diagram and photographs. *A High Efficiency Incandescent Lamp* describes the principles of operation, and the steps by which the lamp was developed. The valuable article on *The Structure of the Atom* is concluded. There is also an interesting variety of shorter articles.

Mixed Fuels Better Than Gasoline

COMPELLED by the exigencies of war to look around for substitutes for gasoline, in the operation of its huge fleet of army motor vehicles, Germany has reached at present a state of perfection in the adaptation of alcohol-benzol mixtures, which a year ago seemed impossible. It has been known for several years that pure benzol, pure denatured alcohol or pure kerosene would not work well in internal combustion motors for automobiles, but the exact requirements in connection with the use of these fuels were not known, because none seemed impressed with the necessity for drastic action. When the war started and the importation of gasoline stopped, steps were being taken by the army authorities which promise to revolutionize automobiling in Germany.

It is openly declared now that even after the war the majority of German motorists will continue to use certain alcohol-benzol mixtures recommended after severe tests by the government. During these tests many new facts were discovered in relation to the use of highly volatile and less volatile fuels, as were also the causes of former failures with alcohol mixtures, benzol, kerosene and mixtures of these with gasoline. The engineering department of the Imperial German transportation department has tabulated a series of experiments with various mixtures of the fuels mentioned, their effective horse-power when compared with pure gasoline and the distances traveled with them, under the identical road and driving conditions accompanying the tests with gasoline.

While, of course, many of the tests and the tabulated results are of merely theoretical value in the United States, and probably would not have created much interest even in Germany, had it not been for the extraordinary demand for motor fuels caused by the extensive use of motor vehicles in the army service—they are none the less interesting to Americans, because they show conclusively that gasoline is not by any means the best and most effective motor fuel for automobiles. When compared with the work of certain mixtures of benzol and alcohol, gasoline must be considered both wasteful and expensive. Pure gasoline of low volatility gives greater horse-power than is needed by the car; therefore it is wasteful and a gallon of it will not carry the car as far as a gallon of the alcohol-benzol mixture.

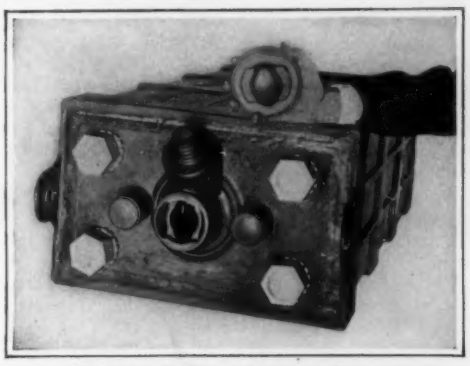
In the course of the experiments the tester used a medium-powered Mercedes touring car, of the 1914 type, the carbureter of which was set for ordinary gasoline and not adjusted in any way during the series of tests. The highest speed obtained, and the distances covered on 1 litre of fuel are given in the following table:

Fuel used.	Speed attained, km. hr.	Dist. traveled on one litre.
1 part benzol with 1 part alcohol....	68 km. hr.	7.5 km.
1 part benzol with 2 parts alcohol...	66 km. hr.	7.2 km.
1 part benzol with 3 parts alcohol...	63 km. hr.	7.0 km.
1 part benzol with 4 parts alcohol...	62 km. hr.	6.6 km.
1 part benzol with 5 parts alcohol...	58 km. hr.	6.0 km.
Pure benzol.....	67 km. hr.	7.1 km.
Pure gasoline.....	70 km. hr.	*5.8 km.

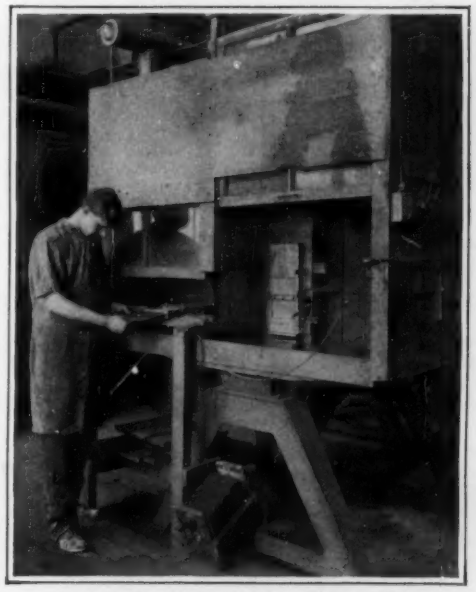
* Distance traveled on pure gasoline is 25% *less* than on the best benzol-alcohol mixture, 1:1.

When the cost of the fuel is taken into account, leaving aside all "war considerations" and counting only the prices of the fuels as they stood in Germany just previous to the outbreak of the war, the balance shows greatly in favor of the alcohol-benzol mixtures. Gasoline cost about 38 cents a gallon; benzol 37.5 cents and alcohol 34 cents. Taking these prices into account, as a basis for determining the cost of motoring the investigator discovered that he could travel 62 km. for $1, if he used gasoline; 76 km, if he used pure benzol, and 84 km. if he used the 1:1 mixture of alcohol and benzol. Strange to say, if the motorist had used pure denatured alcohol, without benzol, his expense would have been exactly the same as with pure gasoline, namely, 62 km. for $1.

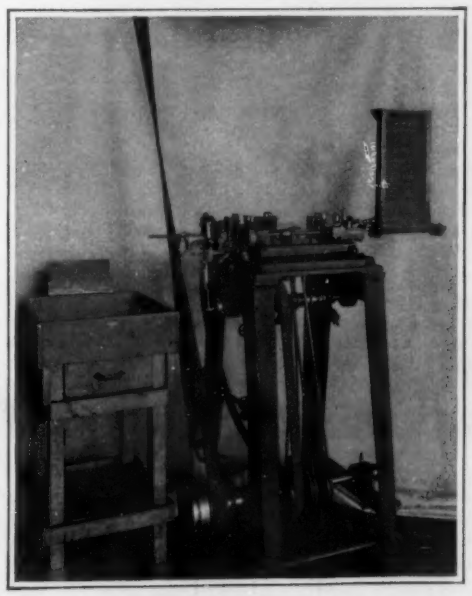
Such performances, not so long ago, would only have caused the motorist to point to the many supposed drawbacks attending the use of less volatile fuels; but the automobile motor of to-day has been improved so greatly that carburetion troubles are minimized. Furthermore, it was chiefly due to attempts to use *one* substitute (either benzol *or* alcohol) that carburetion troubles arose. Benzol, if used alone, requires considerably more air for complete combustion than gasoline; and gasoline carbureters refused to work properly when called upon to handle benzol or alcohol. On the other hand, alcohol can be compressed far more, requires less air and can stand greater heat without pre-ignition than gasoline. Mixtures of alcohol and benzol, calculated so as to equalize the excess of air required by benzol with the excess of fuel required by alcohol, can be used in the ordinary gasoline carbureter without any adjustment whatsoever, as far as the air inlet is concerned. Such mixtures will not form any carbon deposits, not even in the oldest type of motors.



The cap and valve that seals the cell



Machine for filling the tubes of the positive plate with active material



Machine for making the fine horizontal saw cuts in the tubes of the positive plate

The greatest drawback to the use of benzol-alcohol mixtures in automobile motors still remains the low volatility of the fuel and the necessity for pre-heating it, or for heating the motor itself. It is very difficult to start a motor on the benzol-alcohol mixture, and in the dangerous work which the motor cars are called upon to perform in the war, this starting difficulty at first was a serious drawback. The German army authorities realized this drawback, and every car was ordered fitted with a small auxiliary fuel tank, in protected position, in which fuels of high explosive force and low volatility are carried; chiefly ether, gasoline and benzene. A three-way cock connects this auxiliary tank with the carbureter. When starting the motor, the auxiliary tank is connected, but as soon as the motor has turned over a few hundred times, the gasoline or ether supply is shut off and the regular fuel tank is connected.

The installation of the auxiliary tank, strange to say, was about the most successful innovation introduced by the German army authorities. It is reported to have saved a large number of motor vehicles from capture by the enemy. Nearly all gasoline tanks (that is to say, the regular tanks) on German automobiles are fitted with pressure feed, and the moment a rifle bullet or shell fragment pierces the tank in its exposed position, the fuel supply is shut off automatically and the car has to stop. But with an auxiliary tank the car may still be operated, by simply turning the three-way cock. The driver is enabled to cover 10 or 15 miles without any difficulty, bringing his car to safety; so that the installation of the "starting" tank has really worked out to even better advantage in providing also a reserve fuel supply for emergency cases.

The general use of benzol-alcohol mixtures by thousands of professional chauffeurs, drafted into army service, is certain to be felt in the field of motoring after the war is over. Motor trucks, even before the war, have been operated to no small extent on benzol-alcohol in Germany, and a strong propaganda is now being waged by the chauffeurs, the Imperial Automobile Club and the military authorities, to extend further the use of such mixtures, with gasoline starting tanks. There is a strong probability that gasoline will be used to a less degree by motorists in Germany, than it was before the war. Popular prejudices, based chiefly on limited knowledge and mis-information, have been conquered, and the strong incentive of "patronizing the home industries" apparently makes it easy to stick to home-made fuel, instead of returning to imported gasoline.

Insects as Spore Carriers

AMONG the numerous diseases of various plants caused by parasitic fungi, none are better known or have received more attention from scientists and the general public than the chestnut tree bark disease which has been recorded from all states in which the chestnut tree grows naturally. The fungus causing this disease is called *Endothica parasitica*, which is killing millions of chestnut trees annually. No efforts on the part of the state and federal authorities are spared in the way of preventing the spread of this disease wherever the presence of the fungus is detected. It was supposed originally that the most frequent and rapid mode of spore dissemination was by wind wafting the spores from tree to tree, and that a good method of combating the disease was by cutting and removing not only the diseased trees, but also those that stood close to them, especially those in the direction of the prevailing winds.

Although the amount of success depended very largely upon the thoroughness, combined with an intelligent method of carrying out the work, it was soon learned that there must be means of spore dissemination other than by wind. Plant pathologists observed during recent years that insects are directly responsible for the spread of certain plant diseases, and the Pennsylvania Chestnut Tree Blight Commission in coöperation with the Office of Forest Pathology, U. S. Bureau of Plant Industry, undertook to demonstrate experimentally whether insects carry spores of the blight fungus. The result of the work conducted on this project by Mr. R. A. Studhalter, formerly of the U. S. Bureau of Plant Industry, and Mr. A. G. Ruggles, of the Pennsylvania Blight Commission, are published in Bulletin 12 of the Pennsylvania Department of Forestry.

A careful study of the findings of the recent investigations dealing with the subject of insects as carriers of the spores of *Endothica parasitica* affords convincing evidence of a real connection between insects and this disease. The only point in doubt now is to what extent the insects are responsible for the rapid spread of the disease. Granted, at any rate, that insects are responsible for a large share in the dissemination of the chestnut tree bark disease, it must be allowed that the study carried on by the Commission is of the greatest importance. It gives strong support to the theory that the spread of other plant diseases are directly traceable to the action of insects.

Feeling Through the Fog by Wireless

A New Means of Locating Vessels at Sea

By Robert G. Skerrett

POSSIBLY it may not be quite exact to say that fog is as much of a menace to the navigator as ever; but it is undoubtedly true that a formidable peril lurks in these visually impenetrable banks of mist. Therefore, both the seafarer and the water-borne passenger have every reason to be interested in the invention of Otto Fricke, an engineer and a former mariner.

The cunning displayed in this new mechanism is twofold. It is a clever combination first of existing facilities of established value, and then this union of forces, so to speak, is made effective through mechanisms that provide a visible guide for the groping navigator. The seafarer is accustomed to depend upon charts, especially when piloting his craft in the neighborhood of the land. Topographical features are permanent, but a nearing ship, hidden by the fog, while just as much of a danger as a submerged ledge or a jutting headland is, however, on the move. Therefore, the thing most desired is that the man on the bridge may know just where this particular menace is and the speed and the direction in which it is advancing. In brief, what is wanted is a chart that changes at short intervals and carries a trace of the unseen vessel's course.

To this end, certain data are necessary. First, the distance off of the invisible craft that is underway, and next some check on her position at chosen intervals of time, this information serving to show both her path and the speed with which she moves onward. Mr. Fricke obtains this information by means of wireless telegraphy and the lagging travel of sound signals, the interval between the arrival of the two messages serving to establish the factor of distance with a reasonably accurate approximation. We say approximation, because it is a well-known fact that intervening strata of different temperatures affect somewhat the speed of transmission of sound waves through the air. But this is not a serious handicap in the case of the field of usefulness of the present apparatus, because absolute exactness at the start is not necessary in measuring the interval between vessels several miles apart.

The velocity with which wireless waves travel is such that their departure and arrival across a gap of 10 miles, let us say, is for all practical purposes instantaneous. While sound waves sent simultaneously with the wireless ones come along afterward seconds later. By measuring the difference in time between the receipt of the wireless and the sound signals thus dispatched from a far-off ship it is possible to come pretty close to determining the remoteness of the sending craft. The invention in question constitutes an apparatus which, in time of thick weather, is continually on the alert, and automatically responds to impulses of the character described and makes a graphic record or series of records, by means of which the navigator is both warned of the approach of another ship and shown just what he must do in order to steer a course that will carry him safely away from or past the other steaming vessel.

Basicly, the registering mechanism is operated by clockwork, which is brought into play by wireless. This machinery causes a series of radial belts—directed toward as many different parts of the entire horizon—to move uniformly outward from a common center. That center represents the ship carrying the apparatus, and each of these belts bears two tinting points placed equidistant, but only one of which is operable during its travel from the center to the rim. Above these belts, which are disposed like the spokes of a wheel, is a translucent disk upon which is marked a series of concentric circles, and each zone typifies a mile. The disk is of paper and removable, so that it can be filed away for record. The method of functioning is as follows:

Upon the arrival of the wireless "dash" from the far-off craft the clock-work is released and all the belts start moving outward from the center taking with them their passive tinting points—passive because they leave no marks. Seconds later comes the sound signal. This is received by a telephone transmitter which, in its turn, closes a circuit which operates a relay. The relay, in its turn, energizes a magnet located within the travel of the belt that happens to point in the particular direction of the source of sound. This magnet acts upon a bit of iron on one end of each of the tinting points carried by that belt; attracts these lower ends; and, in the case of the one on top, brings its coloring tip up sharply against the under side of the translucent paper disk. Just where the mark is then made shows the direction as well as the distance off of the unseen craft that dispatched the operative signals. The mechanism comes to a halt when the upper pen has reached the outermost limit of the belt, and, at the same time, the second tinting point is ready for action at the central starting point.

Again, a few minutes later, the remote ship repeats the sending of her dual signals—wireless and sound, and once more the clock-work functions, starting the belts rimward with their markers; and when the sound impulse arrives later the record is made—only that tinting point responding, as before, which at that instant points toward the fog-hidden vessel. Thus it goes on from time to time, and upon the paper disk are dotted the successive positions of the distant craft in relation to the vessel warned. First the tell-tale dot is in the neighborhood of the outer zones, and gradually the succeeding dots come closer and closer as the two steamers draw nearer to each other. It is understood, of course, that the idea is that all liners should be equipped with an outfit of this sort; and once two vessels have established the fact of their proximity in this way, they would alternate in sending signals and thus give each other a graphic story of their respective courses, distances, and speeds.

The direction-determining part of the apparatus hinges upon the placing of the sound detectors at points around the ship's deck corresponding to the radial positions of the several pen-carrying belts; and the telephone transmitter or detector in any one of these positions controls only the tinting point of its associate belt. To prevent operative confusion, each sound detector is blanketed by flanking walls so that it can receive sound impulses coming only from a limited sector of the horizon. But should three of these mechanical ears pick up the signal—each making a mark on the disk, the true direction would normally be the mean position; and the same would be the case should two of the detectors respond to the sound waves.

Primarily, the apparatus is designed for service on the open sea or upon fairly expansive waterways where the signals would be exchanged over distances of some miles. However, should a number of vessels be concerned they would alternate in sending their signals, and this can be just as easily arranged in the case of the combined wireless and sound impulses as it is now commonly practiced in sending either of these signals. Of course it is understood that the first purpose of the instrument is to pick up sounds that would not readily be detected by the ear, and in this manner to discover and to place a far-off ship, thus giving an ampler period of warning—in effect a wider margin of safety.

This same sound-recording apparatus is equally capable of serving to detect icebergs or any other sound-reflecting body. For this purpose the ship's whistle is blown *before* the wireless "dash" is dispatched, or the clock-work can be released by hand immediately after the siren blast. As the sound has to travel to the reflecting surface of the hidden menace and then back to the telephone detectors the clock-work is arranged then to run at half speed. In this way the true distance of the iceberg or other menacing mass can be determined by means of the echo.

The New York Motorboat Show

THOSE who had an opportunity to visit the Motorboat Show, which was held at the Palace last week, certainly had occasion to congratulate themselves, for it undoubtedly presented the best collection of real boats, both in numbers and in variety of styles and models, that has ever been gathered together at one of these popular exhibitions. Almost every description of boat, from tiny rowing tender to lordly cruiser, which, with its silky black sides towered in the halls of the Palace like an ocean liner, was to be found, something to match every taste and every requirement. One class, however, which has been prominently represented at most of the previous shows, was missing, and this was the racer, for the racing machine of to-day has become such an expensive and formidable combination, three parts engine and one part boat, that there are not very many craft in existence that can rightfully claim title to a place in the championship class, and there is little inducement to the builder of such a boat to exhibit his creations for the benefit of trade rivals.

The most diminutive boat in the show was an atom of a hydroplane that was about the size and shape of a shingle, but powered with a "V" type aeroplane engine it boasted of a speed of thirty-five miles an hour. Needles to say, it was a decidedly smooth-water affair. A novel feature of this craft was the mounting of the rudder on a skeleton outrigger that extended several feet behind the wheel.

Among the pleasure boats the smallest specimen shown was the homely little "jitney," a flat-bottomed skiff model, with the wheel located in a rectangular stern tunnel, and a little motor stowed away in a sort of vest-pocket compartment amidship. Starting from this lower extreme the line extended upward through a delightful series of graceful runabouts in mahogany and teak to the lordly 60-foot cruiser above mentioned, which was finished in elaborate detail and luxury and powerful enough to sail on any sea. Two splendid lifeboats were also shown, impressive on account of their sturdy construction and powerful models, one of which was fitted with a motor located within a water-tight housing amidship.

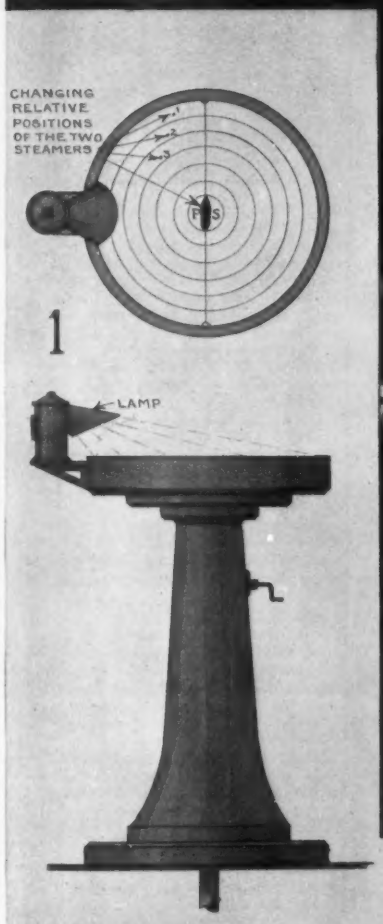
Cruisers having complete living accommodations are growing in popularity, and the competitions instituted by various associations, first as tests of reliability and seagoing qualities, have developed into speed contests as well, and one of the large boats shown has achieved quite a reputation in this direction. This craft is of the now popular "V" bottom type, a method of construction that is being widely adopted, and there were several handsome specimens of this type shown; but the older round bottom, or displacement model, still holds its own, as is evidenced by the number of handsome and speedy runabouts seen in the exhibition, and these formed attractive pictures with their immaculately polished hulls, gleaming metal work and luxurious passenger accommodations.

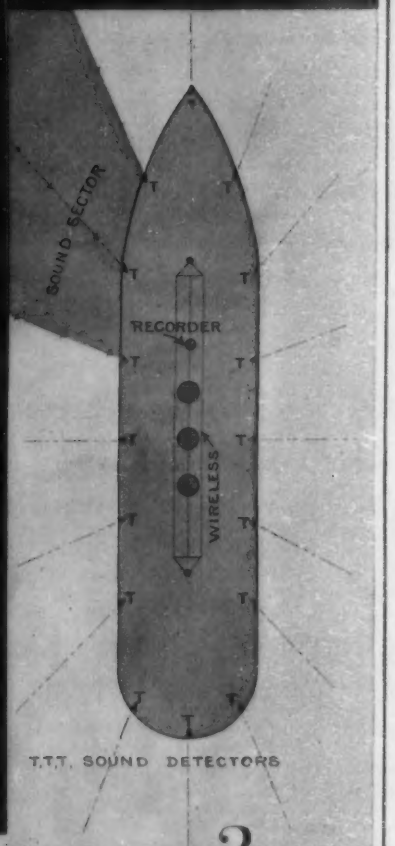
While the finished boats were the most prominent features of the show, the exhibition of engines was equally important and interesting, and a striking feature of the exhibits was the almost universal practice of inclosing all working parts. This method of design makes the motor so cleanly that the owner-operator is not now compelled to don overalls when going out for an afternoon run, and the smooth, enameled casings add greatly to the tidiness and attractiveness of any craft. In every direction there was evidence of unusual attention having been given to refinement in both design and workmanship, and the comparison between the engines of to-day and those of five years ago is most striking. This refinement is the most prominent feature of the motors shown, but there are a few notable novelties, one in particular being a new "express" model, specially designed for use in the fast cruiser, which is becoming so popular, or in the speedy runabout. In such craft high power in a compact form is required, and the engine must necessarily run at high speeds for considerable periods of time. In the past such engines were difficult to operate because of the liability of the bearings to heat, and the watchful attention of an expert was necessary to avoid a breakdown. In the engine in question, in addition to bearings of a liberal size, a forced feed system of lubrication is introduced which insures that all bearings are constantly flooded with oil. The surplus oil, together with that which has flowed over the bearings, passes to the base and is utilized to lubricate the wrist pin and pistons by the splash; but the notable feature is the water-jacketing of the lower part of the base, which thoroughly cools the oil before it returns to the pump to be circulated again. This not only maintains the oil in better condition, but insures a double cooling of the fast moving shafts and pins. Another novelty was a two-cycle motor which was provided with pumps that drew the mixture from the carbureter and forced it into the cylinder, thus insuring more perfect scavenging and a fuller charge than is attained by the ordinary system of base compression.

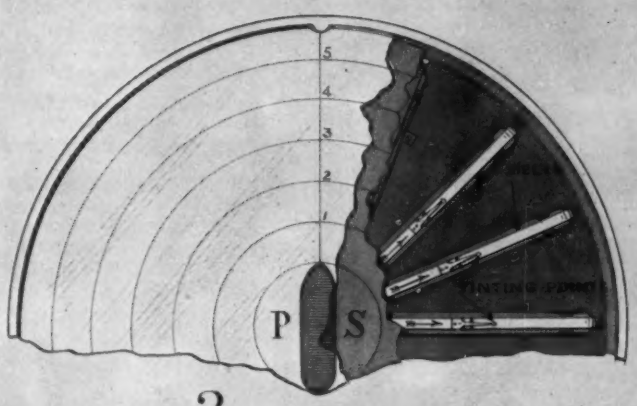
There was one Diesel type engine, suitable for yacht work, and several oil engines of the hot bulb type, especially designed for heavy duty in commercial vessels; and these were well worthy of careful study, as the use of internal combustion motors in working boats, in place of steam, is rapidly becoming of greater importance. Indeed, if the price of gasoline continues to increase, we may expect another year to see motors of this type offered for use in pleasure craft. It is certainly a question that has so far received too little attention from builders generally.

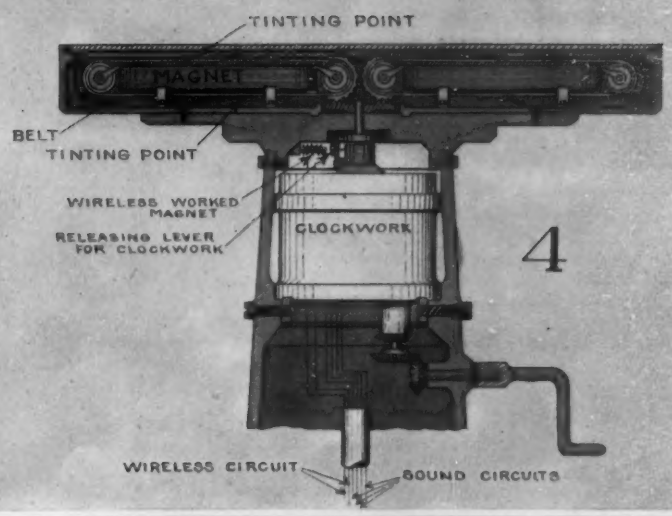
An attractive assortment of accessories was shown, to me every requirement of the motorboatman; but the star feature of this department was the gyro ship stabilizer, which was shown in actual operation, attached to a model section of a boat which, by an ingenious mechanism, was caused to roll in a very natural and suggestive manner. The attachment here shown, which would be suitable for a craft of about three tons displacement, was very compact, and its control over the movements of the boat is one of the marvels of modern science.

Spaces were occupied by the New York Naval Reserve, the Junior Naval Reserve and the New York Nautical College, where displays of an educational character added variety to a notable exhibition.









FEELING THROUGH THE FOG BY WIRELESS. A PHOTOGRAPH OF THE INVENTOR IS SHOWN IN THE MIDDLE OF THE PAGE

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Pertaining to Apparel

ADJUSTING DEVICE.—W. DEUTSCH, 683 Broadway, New York, N. Y. The invention relates to trousers, vests, suspenders, garters, hose supporters and like articles, and provides a device arranged to permit convenient adjustment of the article with a view to shorten or lengthen the same or to adjust a portion thereof between spaced points.

Pertaining to Aviation

STABILIZER FOR AEROPLANES.—A. B. THAW, 640 Park Ave., Pittsburgh, Pa. The invention provides an apparatus operable both manually and mechanically; provides means automatically adjustable for regulating the angle of stability; provides means for varying the angle of stability coincident with the operation of the steering and equilibrating mechanism; provides means for manually setting the automatic stabilizing mechanism without limiting the operation of the same; provides an automatic mechanism adapted to operate at the beginning of movement from the adjusted plane of stability; and provides means for inaugurating the operation of the stabilizing mechanism.

Of Interest to Farmers

GRAIN CONDITIONING AND TEMPERING MACHINE.—W. S. BARKER, Box 55, Auburn, Ky. In the present patent the invention has reference to improvements in means for treating grain previous to milling and has for an object the provision of an improved structure through which grain may pass for conditioning and tempering to any desired extent.

TRANSPLANTER.—C. T. PELTON, Fallon, Nev. This invention provides a strong and inexpensive plant box, wherein a large number of seeds can be expeditiously planted and will be held during germination, and after sprouting, without danger of the roots of the various plants becoming tangled.

Of General Interest

MOLD CLAMP.—W. BENDER, 13 Grove St., Winfield, L. I., N. Y. This invention relates to molds for forming concrete columns and similar structures. The aim is to provide a mold clamp, which is simple and durable in construction, and can be easily applied for securely holding the mold sides in position against spreading.

TOY SAVINGS BANK.—C. A. HILL, 334 W. 53rd St., New York, N. Y. This inventor provides a savings bank arranged to permit of conveniently introducing coins of different denominations, to prevent surreptitious abstraction of the accumulated coins, and to allow of conveniently opening the bank at the time the same is filled with coins.

Hardware and Tools

KNIFE.—W. R. BROWN, Union Cutlery Co., Olean, N. Y. An object of this invention is to provide a lock actuated by the usual spring of the knife for engagement with the blade of the knife and a disengaging lever for throwing out of operation the spring in order to allow the blade to freely swing for permitting a ready closing thereof.

SELF-LOCKING SAFETY CATCH FOR HAND BAGS.—G. H. GENTZEL, 1231 Park Ave., Hoboken, N. J. The invention has particular reference to temporary fasteners for holding the jaws of a handbag shut. It provides a means of a simple, cheap and reliable nature adapted to prevent a surreptitious opening of a handbag by means such as would ordinarily accomplish such result on handbags equipped with fasteners as ordinarily made.

Machines and Mechanical Devices

AUTOMATON SIGN.—R. J. SCHUHMANN, 4823 South 3rd St., Louisville, Ky. This improvement provides a sign with power means for moving a section thereof in simulation of the action of a living figure; provides a power means for the purpose set forth operable in correspondence with the motion of a vehicle by which the sign is carried; and simplifies the mechanism of said power means.

GATE VALVE—R. J. RILEY, Livermore Falls, Maine. This invention refers to gate valves of low pressure, mainly used for controlling the flow of semi-fluid substances or diluted paste materials such as paper pulp or any other similar substances. It provides a valve which can be easily and quickly cleaned, so as to facilitate the closing or complete opening of the valve no matter in what position the gate or the valve may be.

INDICATING DEVICE.—J. W. FRITCH and DELIA E. HOOPES. Address Mrs. Delia E. Hoopes, 1406 Meridian Place N. W., Washington, D. C. The invention is designed to be used in connection with other machines, such as punching or tabulating machines, and the main object is to provide a device by means of which one can ascertain whether a certain key which he desires to operate has, as a matter of fact, really been operated.

Medical Instruments

THERMOMETER.—F. S. DICKINSON, care of Becton, Dickinson Co., Rutherford, N. J. The invention provides means whereby the mercurial column or thread of the clinical thermometer may be quickly and conveniently shaken down or lowered without liability of breakage such as is liable to occur in such thermometers as ordinarily constructed, and improves and simplifies the construction of the carrying case or sheath so as to lessen the liability of loss or misplacement of the parts thereof and to facilitate the introduction and removal of the thermometer therefrom.

Prime Movers and Their Accessories

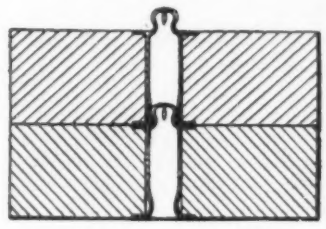
ENGINE CONTROL.—L. J. CRAWFORD, Electra, Tex. This invention relates to engine controls, and has reference more particularly to means for controlling an internal combustion engine which is adapted to prevent fuel combustion when the power-transmitting element, for any reason, has interrupted the transmission of energy.

Railways and Their Accessories

DOOR.—W. O. THORP, Brainerd, Minn. This invention provides a door for use as a grain door in freight cars, wherein the door is sectional, and the sections are movable with respect to each other to provide for various widths of door openings, and wherein each section has means at its outer end for engaging the sides of the door opening to prevent lateral movement of the door, and wherein means is provided for moving the sections and for holding them in adjusted position.

Pertaining to Recreation

CHECKER.—J. F. ROGERS, 1315 Chapline St., Wheeling, W. Va. The object of this invention is to provide means for securing one checker or game piece on another when the latter is crowned, and to prevent the separation of the pieces by casual movement or otherwise, and also to facilitate handling of the same. This is produced by having a metallic



CHECKER OR GAME PIECE.

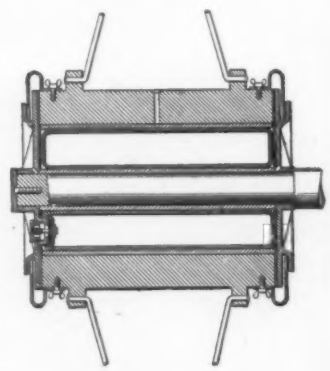
tubular element run through the center of each checker, the tubular element being provided with clip flanges which engage opposite sides of the piece, the tubular element being provided with a projecting snap device at one end and a socket to receive a corresponding snap device of another checker at the other end.

SPOON.—J. A. SERENIUS, Shelton, Wash. The invention provides a spoon for trolling that closely simulates the action of a fish, while being trailed through the water, and the spoon of sheet metal is provided with a propeller for rotating the same as it is drawn through the water, the sheet metal being so shaped that the rotation of the spoon will present the outline of a fish, and the spoon is provided with a bait hook connected to the spoon by a leader, the spoon being connected to the line and the hook so that the rotation thereof will not interfere with the line or the hook.

Pertaining to Vehicles

DELIVERY TRICYCLE.—W. A. BARNES, 21 104th St., Seaside, Rockaway Beach, L. I., New York, N. Y. This invention provides a tricycle having a novel frame structure whereby a flat platform for carrying baskets and the like is arranged in front of the steering post and between the latter and steering wheel, such platform having means whereby a plurality of baskets can be detachably locked thereto and, furthermore, the frame may be formed with a rear extension or platform for carrying additional baskets or the like.

WHEEL.—J. B. CUMMING, Ellersile, Auckland, New Zealand. This invention relates to a vehicle wheel characterized by the provision of a pneumatic cushion in the hub of the wheel for the purpose of reducing the shocks



VEHICLE WHEEL.

and vibration due to the weight applied to the wheel during the movement of the load on the wheel. It provides a pneumatic wheel in which the parts subjected to wear are so positioned that they can be easily and quickly inspected and replaced.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

"Are the Bearings so very important, Dick?" "They certainly are, Mary."

"Because it can be truthfully said that the car we buy is only as good as the Bearings upon which its mechanism is mounted.

"They carry the weight of my loaded car—resist the shocks and jars of the road—nullify the stresses and strains imposed upon the entire mechanism—and at the same time reduce friction to the vanishing point wherever rotating motion occurs in the chassis.

"The overcoming of friction means much to me, because friction causes rapid wear and waste of power. By conserving this power I am enabled to get greater mileage per gallon of gasoline and oil. The saving of wear also pulls down my upkeep expense."

"I've been asked that question many times lately," said the salesman.

"And I want to say that *our* cars are equipped with New Departure Ball Bearings. These Bearings have been selected by our engineers because of their unexcelled efficiency proven by the severest experimental and practical service tests.

"Then again," continued the salesman, "New Departure Ball Bearings are noiseless and foolproof—and by their own inherent durability extend the life of the car itself.

"Like everything in this car, Sir, the New Departure Ball Bearings are absolutely guaranteed."

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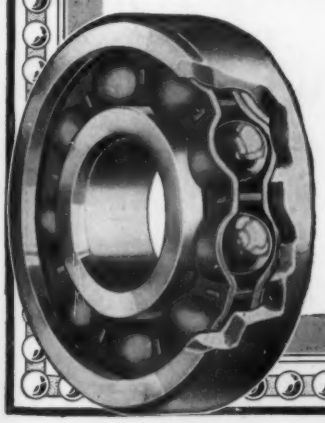

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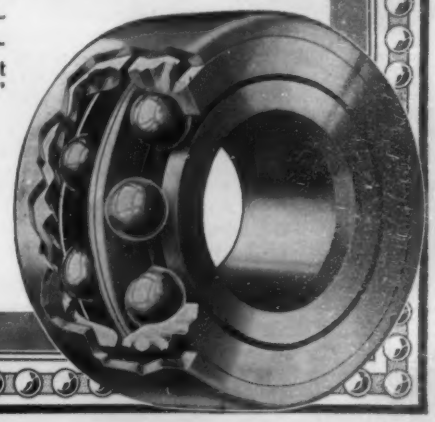
A single, self-contained, "fool-proof" unit carrying all the loads and stresses simultaneously from whatever direction they may come, with equal efficiency, and reducing friction to the vanishing point.



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Industrial Preparedness for Peace

(*Concluded from page* 177)

of coal-tar colors. Of this amount 3,300 tons were made in the United States, from semi-manufactured material, imported chiefly from Germany. We imported 25,700 tons of artificial dyes from Europe—22,000 coming from Germany. To-day twelve American companies—six organized in the course of 1915—are manufacturing artificial colors at the annual rate of 18,000 tons.

There is a confident expectation that 1917 will see the bulk of the coal-tar colors, used in our diverse industries, made in our own factories from American raw material.

Never before, in our own or any other country, has so complex and intricate an industry been organized and created in such a short time! It is inspiring in its revelation of what American pluck and energy can accomplish when put upon their mettle!

There remain two more fields—two still greater fields—in which these characteristics of the American technical chemist must make themselves felt and that right promptly.

Potash is an indispensable constituent in the food ration of our crops, and a variety of its salts is required in medicine and the arts. Our annual supply, valued at nearly $17,000,000, is derived entirely from the German mines of Stassfurt.

In our unlimited veins of feldspar, in the vast deposits of Utah alunite, in the brine of various western lakes, in the kelp of our western littoral, we have natural sources of potash ready to respond to intelligent and organized activity on a grand scale. The kelp of our Pacific coast, alone, offers an annual harvest worth, at ante-bellum rates, $90,000,000.

Of still greater importance for agriculture, for the arts, and notably for military preparedness, is the factor of nitrogen. We send abroad annually $30,600,000 for nitrogenous material, $17,660,000 going to Chile. Civilized life is unthinkable, national defense against invasion impossible without an adequate supply of nitrogen in a combined form. The complete conquest of the air, the industrial transmutation of the invisible medium, in which we live and breathe, into the hand maid of American industry, is the grand problem now confronting our nation's chemists.

I have passed in rapid review and in a somewhat cursory and summary manner the more salient features which mark the mighty industrial revolution moving on swiftly but almost silently about us.

Its consummation is inevitable. A year or two hence should witness the entire cycle of industries, needed to make our national life well-rounded and complete, adequately established and permanently rooted in American soil.

A few years later should witness our ability to not only meet the country's needs in scores of branches, for the products of which we have hitherto depended upon European brain and brawn, but to boldly sally forth into the world's markets, and meet on even terms the present dominating factors.

What has been accomplished with the products of our iron mines and our pine forests, as well as with the many triumphs of American mechanical genius, can surely be achieved in the remaining fields of technical effort by a similar use of resoluteness and energy—after all, the greatest of our national assets!

NOTE.—The SCIENTIFIC AMERICAN will publish at an early date a complete study of the existing "potash famine" and of the means available for establishing a complete independent potash industry in our country; and later a similar study on the present outlook for the creation of an American nitrate industry.

NEW BOOKS, ETC.

THOMAS ALVA EDISON. By Francis Rolt-Wheeler. New York; The Macmillan Company, 1915. 12mo.; 201 pp.; illustrated. Price, 50 cents.

This short but authentic biography of Edison is a splendid book to place in the hands of a boy. If he is old enough to read at all, he is old enough to enjoy its anecdotes of the youth and manhood of our American Wizard. Underlying the whole account of early struggle and final victory is a lesson in moral principles that is none the less forcible for being so unobtrusive.

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BUSINESS OPPORTUNITIES

MANUFACTURERS OF BICYCLES, motorcycles, automobiles, etc., are invited to make inquiries concerning the new solid tire resilient wheel described under "Recently Patented Inventions" in this issue. J. B. Cumming, E. Heralie, Auckland, N. Z.

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YOUR INVENTION may come within our Laboratories' work. If so our Business Department will consider it. Copy of patent with stamps for return will receive prompt attention. McCormick Laboratories, Dayton, Ohio.

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WILL SELL OUTRIGHT Device for the destruction of wild shrubbery bushes and weeds. Is a labor saver for the improvement of farm lands, especially pasture and unreclaimed ground. Labor Saver, Box 773, New York City.

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WANTED—MEN AND WOMEN to qualify for Government positions. Several thousand appointments to be made next few months. Full information about openings, how to prepare, etc., free. Write immediately for booklet C.G.-25. Earl Hopkins, Washington, D. C.

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WORKING DRAWINGS FOR AMATEURS—Details of Air Compressor, Speed Lathe, etc. Lathe work only. No complicated core boxes. Send for list. Henry Parker, 918 Eighteenth Street, Oakland, California.

THE PLANE THEORY EXPOSED. Compiled by David Nield. Published by the Author, Wellington, N. Z. Price, 1d.

EDEN'S INITIAL DAY-LINE. By David Nield. Willington, N. Z.

The first of these tracts presents proofs of the earth's sphericity. The second urges, from a religious standpoint, that the march of the days be held to commence at Lake Van, in Armenia, instead of at a point in the Pacific Ocean. Mr. Nield is thus assuming, of course, that Lake Van marks the site of Eden, the birthplace of mankind.

BUSINESS DIRECTORY OF THE MANUFACTURERS AND DEALERS LEAGUE. 1915. Office, 2625 Grand Central Terminal, New York.

This directory, issued by The Manufacturers and Dealers League of the City and State of New York, gives its officers and directors, classifies firms according to the nature of their business, and appends an alphabetical list of its members.

MEN OF THE OLD STONE AGE. Their Environment, Life and Art. By Henry Field Osborn, Sc.D., LL.D., Curator Emeritus of Vertebrate Palaeontology in the American Museum of Natural History. New York: Charles Scribner's Sons, 1915. 8vo.; 545 pp.; illustrated. Price, $5 net.

The author is to be congratulated upon the unique opportunities afforded him by his "Palaeolithic tour" under the guidance of such distinguished archaeologists as Emile Cartailhac, Henri Breuil, and Hugo Obermaier; and the reading public is to be congratulated in that this opportunity fell to the lot of a man so well equipped to absorb its wealth of knowledge and suggestion, and to translate significant facts and findings into our everyday language. His introduction shows how closely the Greek conceptions of man's origin conformed to modern theories; it follows the rise of anthropology, traces geographic and climatic changes, and deals with the migrations of mammals. In the main body of the work the Java ape-man, the Heidelberg and Piltdown discoveries, the Neanderthal race, the Grimaldi skeletons, and the Crô-Magnon remains are severally discussed in a series of most fascinating papers. The environments and industries of these early men are restored for us by the skilled pens of writer and artist, and the art of the cave-man is placed before us in all its original lines and colors. Maps and charts abound, and there is a folding insert showing the region traversed by the author in his motor tour through the Palaeolithic caverns of Italy, France and Spain.

PAINTING BY IMMERSION AND BY COMPRESSED AIR. By Arthur Seymour Jennings, F. I. R. D. New York: Spon & Chamberlain, 1915. 8vo.; 272 pp.; 150 illustrations. Price, $3.50 net.

In numerous cases and under a wide range of conditions the application of paint by dipping or spraying has proved to be superior to brush-work in time-saving, in thoroughness, and in durability. An instance of the time saved on particular work is that of enameling the body of a small touring car; by the "flowing-on" process, a complete coat is applied in two minutes. The various modes of painting by immersion, with the kinds of paint called for and the requirements of different trades, are described by the work in hand. Spraying by the use of compressed air is discussed at length, and the hundred and fifty illustrations show plants, methods, and machinery in the fullest detail.

MODES OF RESEARCH IN GENETICS. By Raymond Pearl, Biologist of the Maine Agricultural Experiment Station. 8vo.; 182 pp. Price, $1.25.

These papers critically examine current modes of research in what is a comparatively new field of biological study. This promising territory touches upon zoölogy at one point and botany at another, and both the laboratory and the agricultural experiment station are exploring its possibilities. The new methods which this new study has evolved, embracing, as they must, chemistry, physics and mathematics, certainly call for as clear an explanation as can be given the student; and this is exactly what the ordinary biometric treatise palpably lacks. Mr. Pearl's text is an excellent introduction to the study of genetics, and is both stimulating and formative.

HURON AND WYANDOT MYTHOLOGY. No. 11, Anthropological Series, Memoir 80. By C. M. Barbeau. Ottawa: Government Printing Bureau, 1915. 8vo.; 446 pp.; illustrated.

The oral narratives of the American aboriginal come under several more or less distinct types. He frequently distinguishes between the true and the imaginary narrative; the Hurons and the Wyandots have traditional tales, or those which deal with myths in general, and "They-went-to-hunt-for-meat" tales, which bear upon guardian spirits or monsters. In Mr. Barbeau's valuable compilation the Huron-Wyandot mythology is tentatively summarized, their cosmogonic and sociological beliefs are given in much detail, folk tales are presented, and other traditions and anecdotes which do not come under the preceding classifications are cited. There is also an admirable series of photographs of the individuals through whom these stories were secured. The volume embodies an arduous labor of love, and has its appeal to the general reader as well as to the anthropologist.

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(14045) W. H. H. asks: Is the principle of the thermos bottle in the vacuum between the inner and outer shells? Is it the vacuum that prevents the heat from passing from the inner to the outer shell, thereby retaining the heat in the liquid in the bottle? The outer shell is cold when the hot liquids are placed and kept in the bottle and remains so (or vice versa for cold liquids). Does the mercury lining on the inside of the outer shell and outside of the inner shell have anything to do with this? Would a bottle constructed on identically the same principle of clear glass (omitting the mercury linings) answer the same purpose as one mercury lined? A. The thermos bottle is described in "Lynde's Physics of the Household," with a cut showing its construction. We send the book for $1.40 postpaid. It is a modification of the Dewar Bulb in which liquid air can be kept for quite a time. It depends upon the fact that heat of low intensity, and great wave length cannot pass easily through a vacuum. To increase its ability to retain heat or keep it out as required, the surfaces of the glass inside the outer coating and outside the inner are coated with silver which acts as a reflector for the heat. Mercury is not used upon the lining of the bottles. Silver is used and the bottle would not act so well without it.

(14046) R. F. asks: Can you oblige the writer with information as to where he may obtain certain scientific facts along the lines of the following list? It is likely that this may have been contained in some of your recent publications. Thanking you in advance for this for which enclosed find stamped reply envelope. 1. A general outline of the history, scope, and origination of the Krupp Steel Works of Germany, including their size, power, etc. 2. An article that will include a sketch of great American inventions and great American inventors. 3. Information as to wireless telegraph as to whether it is considered an American invention or not. 4. Confirmation of a statement that the following inventions can be considered strictly American: 1st—Cotton Gin; 2nd—Steamboat; 3rd—Locomotive; 4th—Electric Light; 5th—Telegraph; 6th—Telephone; 7th—Phonograph; 8th—Wireless Telegraph; 9th—Aeroplane; 10th—Wireless Telephone; 11th—Moving Picture. A. 1. It is doubtful if such information as you seek, concerning the Krupp Works in Germany can be obtained. 2. Sketches of inventors and inventions will be found in any good Encyclopedia, especially in the Encyclopedia Britannica, both of American and those of other nations. You will find most valuable aid in this direction from our book, "Byrn's Progress on Inventions in the Nineteenth Century," which is now out of print. 3. The first successful wireless telegraph was invented by Marconi, an Italian. 4. The inventions you name were not invented in any one country. They were as follows: Cotton Gin, Whitney, American; Steamboat, English and American, the earliest were English; Locomotive, English, Stephenson; Electric Light, Davy, English, 1809. After the dynamo came many inventors in America and Europe; Telegraph, Morse, American, invented the dot and dash alphabet, and the automatic register, which made the work practical; Telephone, the first by Reis, German. The final practical speaking telephone, Bell, American; Phonograph, Edison, American; Wireless Telegraph, Marconi, Italian; Aeroplane. Wrights, American; Wireless Telephone, not yet completed; Moving Picture, Edison, American. You can get full details from any library and you have a most excellent library within walking distance of your home at Pratt Institute, Brooklyn, where the attendants are most willing to afford you all the assistance in their power to obtain information.

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Levelling the mixture by means of a template

Hand finishing with a wooden trowel

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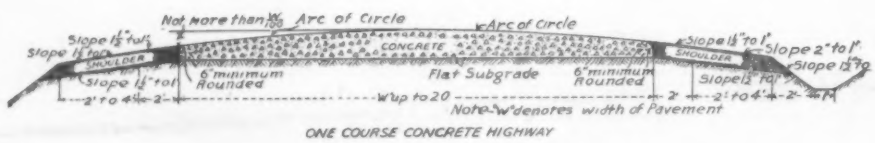

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"The fact that we have over one hundred miles of concrete road in Wayne County, some of it in its sixth year of service, without the semblance of a rut, without a single 25-foot section having been taken up and replaced since we have been building and developing this type of road, is ample justification in our opinion, for the adoption of the concrete road as our standard type of construction. It is comparatively low in first cost; it is free from dust; it furnishes good traction for all type of vehicles; it is not slippery; it is durable; it does not require excessive yearly maintenance charges; and it is usable three hundred and sixty five days in the year irrespective of weather conditions."

If you are interested in building good roads in your community, write to us. We will gladly furnish any road commissioner, contractor, engineer, taxpayer or community full information regarding concrete roads, their construction and maintenance. We have for free distribution a limited number of copies of *"The Proceedings* (210 pages) of the *National Conference on Concrete Road Building"* (an organization of Highway experts.)

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